A
UNIVERSITY OF MICHIGAN
OCT 16 1953
ECONOMICS LIBRARY

JOURNAL of FARM ECONOMICS

Annual Meeting, Corvallis, Oregon, August 18-20, 1953

CONTENTS

MAJOR ARTICLES:

Freedom and Security as Policy Objectives ....*Erven J. Long* 317

Factors Affecting the Accuracy of Price Forecasts..*Karl A. Fox* 323

Productivity and Substitution Coefficients in Pork Output ...
.....*E. Heady, R. Woodworth, D. Catron and G. Ashton* 341

Price Expectations and Production Plans..*Willard F. Williams* 355

The Integration Process and Agricultural Problems .....
.....*Stephen L. McDonald* 371

The "Labor Vacuum" and Cotton Mechanization .....
.....*James H. Street* 381

Hedging—How Effective Is It? .....*Truman F. Graf* 398

•

THE AMERICAN FARM ECONOMIC ASSOCIATION
Volume XXXV AUGUST, 1953 Number 3

NOTES:

Optimum Rate of Laying Flock Replacement ..... *W. B. Back and M. H. Becker* 414

Program Analysis in Water and Land Management Agencies ..... *Charles Tiplitz* 423

Theory of the Kinked Output Path Response ..... *Robert L. Clodius* 427

Rural Industries and Agricultural Development ... *John M. Kuhlman* 436

PUBLICATIONS RECEIVED 439

BOOK REVIEWS:

Thedore W. Schultz, *Economic Organization of Agriculture*..... *Karl Brandt* 441

Earl O. Heady, *Economics of Agricultural Production and Resource Use* ..... *David L. MacFarlane* 444

John D. Black, *Introduction to Economics for Agriculture*..... *Rainer Schickele* 446

S. V. Ciriacy-Wantrup, *Resource Conservation: Economics and Policies* ..... *John W. Hicks* 447

D. A. MacGibbon, *The Canadian Grain Trade 1931-1951*. *R. B. How* 450

John D. Black and Ayers Brinser, *Planning One Town* ..... *Raymond J. Penn and Larry Kristjanson* 451

United Nations, *Preliminary Report on the World Social Situation* ..... *Ernest Feder* 453

J. E. Spencer, *Land and People in the Philippines*.. *Roland R. Renne* 455

Lloyd H. Fisher, *The Harvest Labor Market in California* ..... *John W. Mamer* 457

Howard L. Parsons, *The Impact of Fluctuations in National Income on Agricultural Wages and Employment;* Alexander Morin, *The Organizability of Farm Labor in the United States*.. *Louis J. Ducoff* 459

Leland G. Allbaugh, *Crete: A Case Study of an Underdeveloped Area* ..... *Lawrence Witt* 461

OBITUARY—Harold Hedges 463

JOINT MEETINGS 464

NEWS NOTES 465

Price: $5 per year, this issue $1.25

Entered as second class matter at the post office at Menasha, Wis. Acceptance for mailing at a special rate of postage provided for in the Act of February 28, 1925, paragraph 4, section 412, P. L. & R., authorized November 27, 1931. Printed in U.S.A.

THE JOURNAL OF FARM ECONOMICS is published five times a year during February, May, August, November and December by The American Farm Economic Association. Yearly subscription $5. Published at Menasha, Wisconsin.

JOURNAL
OF
FARM ECONOMICS

Volume XXXV AUGUST, 1953 Number 3

FREEDOM AND SECURITY AS POLICY OBJECTIVES

ERVEN J. LONG
University of Tennessee

A TWENTY year continuum in the development—or degeneration, according to one's views—of farm policy appears, superficially at least, to have been broken. Now is a time for appraisal—for a redecorating or even a remodeling of the old structure. Since it is much easier to find than to correct faults there is much hard work to be done. And if economists can contribute a little to the remodeling job, we should hope that the edifice would be better for it.

As usually occurs at a time of reappraisal, attention seems to be centering on the issues of "philosophy"—as distinct from narrower issues of procedure—which underlie farm policy considerations. It would seem to be proper at this time to focus our sights upon goals, to reconsider basic values to be served, to re-examine the postulates and propositions built into our thinking about agricultural policy questions.

In any event, most recent public (i.e. political) discussions of farm policy have placed their emphasis upon underlying "philosophy."[1] And although day to day policy decisions are and have to be made in a procedural context, declarations of philosophical premises may be expected eventually to influence in an important way the character of policy decisions made.

For these reasons it is fitting that agriculturally interested social scientists who have been giving thought to issues of such a "philosophic" nature should express themselves while such a "philosophy" is still a-building —before our policy makers settle down to the more mundane functions of proceduralizing the adopted philosophical tenets into going policy programs. This is the justification for this attempted comment upon one such underlying philosophic issue.

The point to which this comment is addressed has to do with the idea

[1] See, for example, "The New Agricultural Policy," by Hon. Ezra Taft Benson, Secretary of Agriculture (reprinted by the Equitable Life Assurance Society) described in a footnote as "an official statement of the principles and philosophy governing the new National Agricultural Administration."

widely held by both laymen and economists that freedom and security are somehow inherently incompatible—that any public policy decision involves a choosing of how much of one of these great value objectives we want at the expense of the other. This argument usually rests basically on the notions that freedom is somehow *inherent* in the individual, that the achieving of security usually requires collective action, and that the expansion of collective action serves always to restrict individual freedom. I should like to examine these propositions.

As I see the workings of our social and economic system, liberty or freedom in the completely abstract sense is in reality meaningless. It becomes meaningful only in specific terms which must include *a structure of opportunities* which makes the realization of the freedom possible. Any freedom enjoyed by any individual consists in a set of securities of expectations concerning the behavior of other individuals and groups. These secure expectations of an individual result from a system of rules—rights, duties, restraints—developed by processes of public action and enforceable at law—which determine what others may and may not do.

Let us take a simple illustration. I own an automobile and have the freedom to use it for my own purposes. What does this mean?

In the first place, I am free to use it because no one else is free to do so, and this is not because no one else *wants* to use it, but because they are restrained by public action and its legal and police processes from doing so. My freedom consists in my secure expectations regarding the limitations of the freedoms of others, and can be achieved only through public action. Every private right and individual freedom has as its condition such a structure of duties and limitations of rights on the part of others.

What is the origin and dimension of my freedom to use my car? For one thing, I have the private right, or freedom, of its use only insofar as is consistent with what is held to be in the public interest. I can use it to drive to work, but not as an instrument of homicide—effective though it might be in this capacity. I can drive it sixty miles per hour in some places, but not above fifteen in others—and in most places (such as across fields and lawns) I may not drive it at all. Thus, this private property right and the associated freedoms are not inherently private, but created by public action presumed to be in the public interest. Private property is a creation of public action.

All this is to say that freedom does not "inhere" in an individual.[2] Any individual freedom exists in consequence of the public organization which defines this freedom and secures it for the individual against the adverse

[2] This is a proposition of fact and should not be confused with the normative proposition that the individual is endowed with the inalienable *right* of freedom.

action of others. *The slave became a free man, not in virtue of anything new put into him, but in consequence of a set of restraints imposed upon others.* The difference between a free man and a slave is that the free man has security in the knowledge that the forces of public action will be used to limit the activities of those who would do him harm or use him against his will for their purposes.

More relevant to our discussion, however, is the fact that my freedom in the use of my car is achieved in virtue of a structure of opportunities which gives this freedom meaning and content. Never does one feel less free than when stuck in a mudhole or snowdrift in an isolated spot. Ownership of a car is meaningless in a wilderness. But with the present vast network of excellent roads it opens up a tremendous array of freedoms. Meaningful individual freedom, then, depends upon the public action necessary (in this case involving a correlative "restricting" of freedom through taxation) to create such a structure of opportunities that a mere desire on my part may become an actually realizable objective.

In terms of the earlier illustration, meaningful individual freedom came into being for the slave only as the structure of social and economic organization opened up patterns of alternatives for him comparable to those existing for a "free" man.[3]

By himself, an individual is anything but free—because only by joining efforts with others can he create a structure of opportunities for translating his "wishes" into realities.[4] By himself, he can only dream, not act. And even his "dreams" would be quite empty of content, except as they are filled with desire-objects created by the organized joint efforts of others. True, it is one of the prerequisite and cherished values of a free society that an individual has the right to choose between alternatives—but in any society those alternatives are defined and created through social processes working toward objectives broader than those of any one individual.

---

[3] It is my hypothesis that one of the principal reasons that the institution of slavery (i.e. legal ownership of persons) survived in the United States after it had been abolished in most "civilized" societies lay in the fact that the American economy was relatively so much more open with alternatives that such a radical institution as slavery was necessary to achieve the same degree of control over persons as could be achieved by seemingly much milder institutions abroad. In the relatively closed economies of the 18th and even early 19th Century Europe, virtually complete control over certain classes of persons could be achieved through land ownership and the correlative institutions brought forward from Feudalism.

[4] Perhaps the best illustration of individuals completely "freed" from public restraints were the American Indians who were banished from their tribes for crimes for which the death penalty was thought not to be sufficiently severe. Such individuals, of course, perished in a slow and torturesome process unless they were able to locate and be accepted by some other tribe, thereby surrendering their newly won "freedom."

In even the most primitive societies, the individual's ability to achieve in any measure the satisfaction of wants which the combination of human and physical resources in the situation makes possible, requires his joining up with other individuals. Such group action permits divisions of functions; but it also requires the development and enforcement of group rules to govern individual action. More importantly, the definition of individual rights and duties in the use of property-objects—i.e. the definition of individual freedoms—is the process by which the society distributes the fruits of this joint action. And the society defines these rights by defining the alternatives among which individuals are free to choose, and the rules of the game which he must live by in his attempt to pursue his purposes.

Perhaps no one has ever had deeper insights into the implications of the basic fact that freedom comes to individuals in virtue of their participation in group activity than did Thomas Hobbes, who realized the instrumental character of the relations among men. According to his argument, the realization of any man's purposes requires the participation of other men's efforts; therefore, the activities of one man are the instruments of the other's purposes. Or, stated differently, one man's activities are means to the achieving of others' purposes. And means, in this sense, are always limited. Since any individual would rather work and have others work for the satisfaction of his own than of others' desires, he is engaged with others in a constant play of power to determine whose interests will be served and to what degree. Thus, this mutually instrumental nature of the relation of man to man is at heart one of power. Conflict of interest among men arises not simply out of the scarcity of means or resources; it would exist where resources were unlimited because these resources could be translated into the satisfaction of wants only by the participation of others who would have to forego the satisfaction of some of their own wants in the process. Two men in an economic Garden of Eden—surrounded by unlimited resources—would each be trying to manipulate the other for his own purposes. And conflict of interest would arise from that simple fact. Conflict arises out of the basic fact that one man's action is a necessary means to the realization of the other's desires; it is a concomitant of social existence. In this setting of inherent conflict the individual enjoys no freedom, except through social organization, because he has no security of expectations regarding the conduct of others. These securities of expectations which bring his freedom into being are achieved only through social organization, which defines the rules that govern his joint participation with others in production activities and that control the use of power in distributing the fruits of this effort. Individual freedom is brought into existence through the institution of public action to channelize the power relations and attendant interest conflicts among men into patterns of conduct and performance alternatives acceptable on the

whole to the participants.[5] In the absence of such social organization and public action, human relations settle down to a sheer play of power against power—a "war of all against all," in which individual life is "solitary, poor, nasty, brutish and short."[6]

Although the above comments have not dealt with agricultural policy problems directly, their implications should, I believe, be clear.[7] Arguments which conclude that freedom and security are inherently incompatible—that public action in behalf of security necessarily restricts freedom—are based upon what I feel to be unfortunately superficial social and economic analysis. The principal effects of these arguments are to force society to make false choices, and to call a halt to policy formation at the precise point where it calls for genuine creativity. For the truly creative and constructive aspect of public policy formation is in the creation of a set of situations which expand to the utmost the total array of human values, and this is forfeited if we conclude without full investigation of all the possibilities of the situation that every gain on one point must necessarily be associated with a loss on another.

This is not to say, obviously, that there are not situations within which the expanding of some specific form of security might not restrict some specific freedom. This is, of course, often the case. But so may the expansion of one freedom restrict another freedom, or the expansion of one security restrict another security. It *is* only to say that there is no inherent conflict between security and freedom as such, nor between individual freedom and public action as such; that, in fact, freedom and security *as pure abstractions* boil down to being essentially the same thing. The

---

[5] A closely related problem is the oft-repeated characterization of the role of government as that of "referee." The basic confusion in this idea is, of course, that a "referee" merely enforces rules already agreed upon. Although this is an important function of government, it is completely secondary to its fundamental function—namely; the developing of the rules under which "the game" is played. As suggested by the above analysis the "rules" are in essence resolutions of existing or anticipated power conflicts among individuals and groups.

[6] Hobbes' tremendously deep insight into this problem (philosophically, the problem of order) has been inadequately recognized in subsequent literature, doubtless largely due to his using the analysis as justification for an absolutistic State. This seems to have rested on his supposition that representative government could not be sufficiently strong and stable to secure a stable order in society. Three hundred years of experience since then, particularly in countries under the influence of the English Common Law system, have demonstrated the inaccuracy of this supposition. However inaccurate his principal conclusion, his formulation of the basic problem and meaning of social organization remains unsurpassed. cf. Hobbes, Thomas, *The Leviathan*, Everyman's edition. Also, Parsons, Talcott, *The Structure of Social Action*, pp. 89-94.

[7] It is not easy to provide references wherein these ideas may be traced out. Many of them are woven through the works of John R. Commons (see for example his *Legal Foundations of Capitalism*, esp. pp. 98-100, and Chapter IX, "Public Purpose"). See also, K. H. Parsons, "Social Conflicts and Agricultural Programs," *This Journal*, vol. XXIII (1941) pp. 743-764.

conflict consists in the simple fact that in the achieving of individual purposes, man stands to man in the instrumental relationship of means to end. "The realization of both security and freedom for the individual is a problem of handling power."[8]

Such an analysis as I have made cannot, of course, give comfort to proponents of despotism. Tyranny from any source, governmental or private, is a manifestation of breakdown of the forces of public action, with the consequence that the larger public finds itself unable to restrain the oppressive powers of the powerful minority, whether this minority be the dictator and his henchmen or the head of a great private economic power center. Totalitarianism emerges only in consequence of a disappearance of effective action on behalf of the greater public. I think, also, that one need not argue the point that in a totalitarian dictatorship the individual loses not only his sense of liberty but all feeling of security as well.

Public policy analysis, to be meaningful, must deal with specific appraisals of the entire array of consequences to flow from alternative courses of action. It must not be fabricated upon slogan, shibboleth or sweeping generalization, nor based upon drastic oversimplifications of the nature of social-economic organization. Glittering generalizations, such as the one discussed in this note about the inherent incompatibility of security and freedom, may be attractive to politicians but social scientists must be careful not to mistake the glitter for gold.

---

[8] A comment from John M. Brewster's personal letter to the author on the manuscript of this article.

FACTORS AFFECTING THE ACCURACY OF PRICE FORECASTS*

KARL A. FOX
Bureau of Agricultural Economics

IN RECENT months three major articles have appeared relating to the accuracy of outlook work. The first of these, by James P. Cavin, described methods used by the Bureau of Agricultural Economics in preparing forecasts of general economic conditions and appraised the accuracy of such forecasts made during 1946-51.[1] The other two, by John D. Baker, Jr. and Don Paarlberg, appraised the accuracy of the Bureau's general demand forecasts and its forecasts of production and prices of wheat from 1922 to 1950.[2]

A comparison of forecasts and actual outcomes gives us a measure of the accuracy which has been obtained in the past. To the farmer who acts, or considers acting, on the basis of outlook information, the historical record also offers the most credible evidence as to the level of accuracy which may be expected in the future. But the record itself does not tell us why a particular level of accuracy was achieved, nor does it tell us how, or whether, the accuracy of future forecasts may be improved. To answer these questions, we must study the structure of economic and natural forces affecting the variable which is forecast, and the accuracy and completeness of statistical information relating to both the forecast variable and the factors which affect it.

In general, price is the economic variable which farmers are most interested in anticipating. The outlook for various demand and supply factors is of value to farmers mainly, though by no means entirely, as a basis for judging probable trends in prices. This article is concerned only with problems of price forecasting, and it approaches the question of forecasting accuracy from an analytical and statistical point of view. Two main questions are engaged: (1) What are the basic limitations to the accuracy of price forecasts? (2) By what means can the accuracy of such forecasts be improved? These points will be taken up in turn.

---

* The author assumes full personal responsibility for the views expressed in this article.

[1] Cavin, James P., "Forecasting the Demand for Agricultural Products," *Agricultural Economics Research*, Vol. IV, No. 3, July 1952, pp. 65-76.

[2] Baker, John D. and Paarlberg, Don, "Outlook Evaluation—Methods and Results," *Agricultural Economics Research*, Vol. IV, No. 4, October 1952, pp. 105-114; also by the same authors, "How Accurate is Outlook?" *Journal of Farm Economics*, Vol. XXXIV, No. 4, November 1952, pp. 509-519.

Basic Limitations to the Accuracy of Price Forecasts

The Bureau of Agricultural Economics makes two general types of advance estimates or forecasts. The first type is made by the Crop Reporting Board and consists in estimating future acreage, production and similar items on the basis of farmers' intentions to plant or of reports on the condition of growing crops. Actual plantings may differ from acreage intentions because of weather conditions at planting time or because of changes in economic conditions and in farmers' evaluations of them subsequent to the date on which the intentions were stated. Advance estimates of production, based upon the condition of growing crops prior to harvest, assume average growing conditions during the remainder of the season. If weather during the remainder of the growing season is more favorable than average, actual production will exceed the advance estimate or early-season indication, and vice versa.

Discrepancies between production indications and actual production are largely due to natural phenomena and in many cases cannot be reduced materially unless we develop bases for forecasting the natural phenomena themselves—such as the amounts and time-distributions of temperature and rainfall. Moderate improvements may be possible in analyzing the effects of conditions prior to the forecast date upon final production and also in the precision with which crop conditions on the given date are estimated. The precision of final production estimates could also be increased, although in general this would involve more costly procedures for obtaining data.

The other type of forecast is more strictly economic in nature. Price is the variable which we are most commonly interested in predicting. But price forecasts for several months to a year ahead are usually based on estimates of the supply and demand factors which influence price. Although forecasts of consumer demand are derived from economic rather than natural considerations, they are similar to forecasts of supply in the sense that both serve an instrumental or "independent" variables in the estimation of commodity prices. The significance of this fact will appear shortly.

Limits to Accuracy When Values of Independent Variables are Known

The form of Equation (1) is typical of the simpler statistical demand functions which are derived for farm or food products:

$$(1) \qquad X_1 = a_0 + b_0X_2 + c_0X_3 + d_1$$

where X_1 = price,

X_2 = production or supply,

X_3 = disposable consumer income,

all considered as actual or final values of these variables; and d_1 = residual errors or "disturbances" in X_1 which cannot be attributed to X_2 and X_3.

Equation (1) represents the average or expected relationship between a commodity price and the final estimates of the supply and demand variables which influence it. In practice we never find an exact relationship between the final estimates of these three variables. There is always some variation in price which cannot be explained in terms of supply and consumer income. The unexplained price variations may be due to a number of factors, including (1) sampling or measurement errors in any or all variables, (2) mistakes in choosing the form of the regression equation to be fitted to the data (as arithmetic versus logarithmic equation forms), and (3) the effects of variables not included in the analysis. Sometimes variables are omitted intentionally because we believe them to be of minor importance; more often we are forced to leave out possibly significant variables because we have no data on them. For these reasons, any estimate based upon a regression equation will be subject to some error.

Suppose we were to set ourselves the goal of predicting the prices of each of a large number of commodities within a certain percentage limit. More specifically, let us say that we hope to forecast the season average price of each commodity two years out of three within 5 percent of the actual outcome. From a statistical viewpoint, the possibility of attaining this degree of accuracy for a given commodity will depend upon the basic variability of its price and the closeness with which it is related to other variables such as its production and consumer income.

The standard error of estimate.—Table 1 presents standard errors of estimate from a considerable number of commodity price analyses for the period 1922-41. Unless better estimating equations were developed, there would be no way of reducing price forecasting errors below the levels indicated in Column (1).[3]

In general, about two-thirds of the prices actually experienced during 1922-41 (the years included in the analyses) will be found to be within one standard error of estimate of the corresponding prices estimated from the regression equation. Price estimates for other years are almost always subject to a larger error range than this.

---

[3] The analyses in table 1 would ordinarily be used in forecasting season average prices several months to a year in advance. Forecasts of a monthly average price made only a few weeks in advance might have smaller forecasting errors than those indicated in Column (1). See also footnote 8 below.

Additional research would probably yield more accurate estimating equations than those underlying table 1 for most of the commodities listed. In general, the potential improvement is greatest for analyses with the smallest coefficients of determination (Column 2).

TABLE 1. SELECTED FARM AND FOOD PRODUCTS: STANDARD ERRORS OF PRICE ESTIMATES BASED ON REGRESSION ANALYSES FOR THE 1922–41 PERIOD

Item[1]	(1) Standard error of estimate (percent of expected price)[2]	(2) Coefficient of determination[3]	Item[1]	(1) Standard error of estimate (percent of expected price)	(2) Coefficient of determination[3]
Retail prices			Milk, fluid use[4]	3.4	.91
All meat	2.1	.98	Condensery milk[4]	9.7	.76
Pork	4.9	.92	Milk for cheese[4]	11.6	.71
Beef	2.4	.96	Butterfat[4]	7.4	.85
Lamb	3.4	.91	Fruits and Vegetables:		
All meat[4]	1.7	.98	All fruits	11.5	.82
Pork[4]	3.0	.97	All deciduous fruits	9.9	.82
Beef[4]	2.9	.95	Apples	6.7	.96
Lamb[4]	2.9	.94	Peaches (excl. Calif.)	16.6	.80
Poultry and eggs:			Cranberries (1922–36)	14.7	.86
Chickens[4]	4.4	.86	All citrus fruits	11.3	.92
Eggs	6.8	.80	Oranges	14.0	.93
Dairy products:			Grapefruit	39.2	.72
Fluid milk	2.7	.87	Lemons, all	36.2	.61
Evaporated milk	3.3	.84	Lemons shipped fresh:		
Cheese	4.1	.84	Summer[5]	16.2	.79
Butter	5.3	.84	Winter[5]	14.0	.88
Farm prices			Potatoes	16.3	.93
All meat animals	7.9	.88	Sweetpotatoes	13.2	.75
Hogs—cal. yr.	14.8	.82	Onions:		
Hogs—Oct.–Mar.	15.3	.81	All	15.2	.89
Hogs—April–Sept.	21.5	.69	Late Summer	27.0	.85
Beef cattle	6.3	.90	Truck crops for fresh market—Calendar year	5.6	.85
Veal calves	5.0	.93	Winter	16.3	.67
Lambs	7.4	.87	Spring	11.8	.49
Poultry and eggs:			Summer	10.4	.87
Chickens	6.2	.86	Fall	10.1	.84
Turkeys	9.5	.90	Feed grains and hay:		
Eggs	8.5	.75	Corn	17.9	.85
Dairy products:			Hay	8.6	.90
All	4.4	.87			
Milk, wholesale	4.6	.88			

[1] Supply variables in underlying analyses are total or per capita production unless noted.

[2] Represents minimum error range attainable 2 years out of 3 under most favorable conditions, *given* the regression equation used. Smaller standard errors could be obtained for some of these prices by data refinements, construction of special series, use of additional explanatory variables, and, for some crops, by using deviations from the 1922–41 average rather than the first differences or year-to-year changes used here.

[3] Unadjusted. Represents the percentage of total year-to-year variation in retail price during 1922–41 which was "explained" by the combined effects of the other variables.

[4] Supply variables in underlying analyses are per capita consumption.

[5] Based on analyses adapted from George M. Kuznets and Lawrence R. Klein, "A Statistical Analysis of the Domestic Demand for Lemons, 1921–41." Giannini Foundation of Agricultural Economics, Mimeographed Report No. 84, June 1943. Prices are measured at the f.o.b. level.

Table 1 indicates that the prescribed level of accuracy—within 5 percent in 2 years out of 3—was attainable for annual average *retail* prices of most food livestock products. The 1922-41 standard errors of estimate for these commodities at retail ranged from 1.7 to 5.3 percent. However, the 5 percent level of accuracy was not attainable for the farm prices of most of these products with the equations used. Analyses for wholesale milk (total and for fluid use), total dairy products, and veal calves gave error levels of 3.4 to 5.0 percent, but those for most other livestock products ranged from 6 to 10 percent. Error levels for hog prices and for cheese milk exceeded 10 percent. The author's analyses of season average farm prices of crops yielded 1922-41 error levels between 10 and 20 percent in most cases. Analyses for apples, hay, and fresh market truck crops (calendar year total) stayed within a 10 percent error limit.

The author's exploratory analyses of United States average farm prices of grapefruit and lemons gave standard errors of estimate in excess of 30 percent! Analyses of the California f.o.b. price of lemons by Kuznets and Klein, using specially constructed series including an index of temperatures in consuming centers, gave standard errors of around 15 percent for the 1921-41 period. Similarly intensive research for other commodities should also lead to more accurate estimating relationships than those underlying table 1.

The standard error of forecast.—The figures in table 1 do not cover any errors of the forecasting type. They indicate the minimum level of error with which we might estimate season average prices *given* the final, official post-season estimates of the supply and demand variables used in each analysis. In fact, the table 1 figures slightly understate the actual 1922-41 error level even in this post-season context. Strictly speaking, the standard error of estimate applies only to the actual observations from which the regression equation was fitted.

For other values, the proper error level is given by the *standard error of forecast,*[4] which may be written, in squared form, as follows:

$$(2) \qquad \sigma_{x_1'}^2 = S^2 \cdot \left(\frac{N+1}{N}\right) + \sigma_{b_0}^2 \cdot x_2^2 + \sigma_{c_0}^2 \cdot x_3^2 - 2\sigma_{b_0}\sigma_{c_0} r_{23} \cdot x_2 x_3$$

where x_2 and x_3 are deviations from the 1922-41 average values of the independent variables; S is the standard error of estimate (as in Table 1); σ_{b0} and σ_{c0} are standard errors of the net regression coefficients of price upon the supply and demand variables; and N is the number of observations to which the regression equation was fitted.

Whereas, the standard error of estimate measures the variability of observations in the original 1922-41 sample about the fitted regression, the standard error of forecast also includes an allowance for uncertainty (sampling error) relative to the exact level of the regression surface and the exact values of the net regression slopes. The effect of the latter type of error increases as the values of the independent variables depart farther and farther from the center of the 1922-41 observations. In the analyses underlying Table 1, the variables were expressed as year-to-year changes (logarithmic first differences). As changes in consumer income and in livestock production from one year to the next are usually moderate, the standard errors of forecast appropriate to first difference

[4] This name is somewhat unfortunate for present purposes. It measures the range of error in an estimate of price based on *actual or final values* of the independent variables. In forecasting *over time,* which is the main concern of outlook work, we have the additional problem of forcasting the independent variables themselves.

TABLE 2. SELECTED FARM AND FOOD PRODUCTS: FACTORS AFFECTING THE ACCURACY OF PRICE ESTIMATES, UNITED STATES, 1922–41

Commodity[1]	(1) Standard error of estimate (percent of expected price)[2]	(2) Standard deviation of actual prices[3] (percent)	(3) Coefficient of determination[4]	(4) Standard deviation of supply[5] (percent)	(5) Effect on price of 1 per cent change in Supply (percent)	(6) Effect on price of 1 per cent change in Demand[6] (percent)	(7) Ratio of standard error to standard deviation of prices[7]
Retail prices:							
All meat	2.1	13.2	.98	7.3	−1.07	.86	.16
Pork	4.9	17.8	.92	13.2	−.85	.93	.28
Beef	2.4	12.3	.96	7.1	−.83	.83	.20
Evaporated milk[8]	3.3	7.7	.84	4.8	—	.59	.43
Butter[8]	5.3	13.6	.84	3.3	—	1.01	.39
Farm prices:							
All meat animals	7.9	23.3	.88	7.3	−1.60	1.43	.34
Hogs	14.8	36.1	.82	13.2	−1.54	1.63	.41
Cattle	7.4	18.8	.90	7.1	−1.19	1.27	.39
Condensery milk[8]	9.7	19.6	.76	4.8	—	1.34	.49
Butterfat[8]	7.4	19.2	.85	3.3	—	1.28	.39
Dairy products, all	4.4	13.4	.87	1.8	—	.98	.33
Apples	6.7	36.3	.96	44.0	−.79	1.04	.18
Peaches	16.6	37.8	.80	54.6	−.67	.96	.44
Oranges	14.0	61.5	.93	31.1	−1.61	1.34	.23
Grapefruit	33.0	67.0	.72	26.4	−1.77	1.29	.49
Lemons, all	36.2	59.8	.61	23.2	−1.69	.78	.61
Potatoes	16.3	72.9	.93	15.0	−3.51	1.20	.22
Onions							
All	15.2	50.1	.89	17.5	−2.27	1.00	.30
Late Summer	27.0	77.9	.85	21.4	−2.90	.72	.35
Corn	17.9	48.3	.85	21.4	−1.93	.89	.37
Hay	8.6	28.8	.90	13.6	−1.63	.96	.30

[1] The supply variables used are total or per capita production unless otherwise noted.

[2] Represents minimum error range attainable 2 years out of 3 under most favorable possible conditions, *given* the particular regression equation used. In some cases, smaller standard errors could be obtained by using original values of all variables instead of first differences. Also, improvements could be obtained in some cases by further refinement of the basic data, by the construction of special series, or by the use of additional or different explanatory variables.

[3] Standard deviations of price for a few crops might be smaller than this in terms of original values, rather than the first differences actually used.

[4] Unadjusted. Represents the percentage of total year-to-year variation in retail price during 1922–41 which was "explained" by the combined effects of the independent variables.

[5] Standard deviations of supply for a number of crops would probably be smaller in terms of original values (effectively, deviations from 1922–41 averages) than in terms of the first differences (year-to-year changes) used here. In the case of corn, for example, the standard deviation of the supply variable used would be only 18 per cent based on logarithms of original values. The inertia in livestock production means that variation from one year to the next is usually smaller than variation around a 20-year average.

[6] The demand variable used in all analyses but those for corn and hay is disposable personal income. The standard deviation of this variable during 1922–41, based on logarithmic first differences, was 12.3 per cent.

[7] Standard error of estimate divided by standard deviation of actual prices.

[8] Supply variable used is per capita consumption of the end product.

analyses for livestock products are seldom very much larger than the standard errors of estimate. This is less true of first difference analyses for crops, where production is more variable. However, if we were to use a 1922-41 regression based on actual values of price, supply, and income (rather than year-to-year changes) to estimate a price for 1952 the standard error of forecast would be extremely large, since income per person in 1952 was nearly three times its mean value for the 1922-41 period.

Factors affecting the standard errors of estimate for selected products.– Table 2 indicates some of the factors that influence the standard error of estimate, which represents the minimum error range attainable using the variables included in the given regression equation. A small standard error of estimate requires (1) high correlation between price and the

independent variables (Column 3) and (2) relatively small variability in the price itself (Column 2). This can be seen by comparing the results for beef and apples, where the difference in standard errors results solely from the difference in price variability, and those for meat at retail and dairy products at the farm level, where the difference in standard errors is due almost entirely to a difference in the level of correlation between price and the explanatory variables.

Columns 4, 5, and 6 show some factors accounting for differences in the basic variability of the various price series as indicated in Column 2. Farm prices of crops (in the absence of price supports) are more variable than farm prices of livestock products, due chiefly to the greater year-to-year variation in crop supplies (Column 4).

The price of potatoes is more variable than that of hogs because the former responds more violently to a given change in supply (Column 5). In other words, the demand for potatoes is much less elastic than the demand for hogs. Some differences in price variability also result from differences in price responses to consumer income (Column 6), the average year-to-year variability of which was about 12 percent during the 1922-41 period. Farm prices are more variable percentagewise than retail prices, due to the presence of some relatively stable or fixed elements in marketing charges. This fact is reflected in Columns 5 and 6, where price responses to both supply and income changes are indicated to be sharper at the farm than at the retail level.

Column 7 gives a measure of the over-all efficiency of each regression equation in terms of the ratio of the standard error of estimate to the original price variability. In a few cases the standard error of estimate is only a fifth as large as the standard deviation; more commonly it is closer to a third as large for the analyses shown.

Limits to Accuracy When Values of Independent Variables Must Be Forecast

When we use statistical regression equations to forecast prices several months to a year in advance we introduce major complications. In addition to the standard error of forecast based on final estimates of supply and demand we have the effects of errors or inaccuracies in our forecasts of the independent variables, particularly production and disposable income. These errors, propagated through the net regression coefficients of commodity price upon the independent variables, may be translated into corresponding errors in our price forecasts. To represent this fact, Equation (1) may be revised as follows:

$$(3) \qquad X_1 = a_0 + b_0X_2' + c_0X_3' + (b_0\delta_2 + c_0\delta_3 + d_1)$$

where X_2' and X'_3 are forecasts of the independent variables, and δ_2 and δ_3 are differences between these forecasts and the actual values or final estimates, X_2 and X_3.

Accuracy of supply and demand forecasts.—Errors in forecasts of the independent variables are almost always decreasing functions of time. In the case of corn, Clough has shown that the production indication reported in July differs from the final December estimate by less than 300 million bushels in two years out of three.[5] In August the corresponding error band falls to about 180 million bushels and in September to about 100 million. Still further improvements in accuracy are registered in October and November, again using the final December estimate as a criterion.

Similar measures could be calculated for any of the crop or livestock production series for which early season indications are published. A related approach can be used in special analyses, such as Breimyer's study of factors affecting cattle and calf slaughter,[6] which shows how each major piece of new information as it becomes available contributes to the accuracy of slaughter forecasts.

It is more difficult to document the accuracy of forecasts of disposable income, as these forecasts have seldom been published in precise numerical form and files of the unpublished BAE estimates are available only for a few recent years.

The sheer inertia of disposable income over periods of 3 to 6 months is an aid to demand forecasts. During 1946-1952 the standard deviation of changes in disposable income from one quarter to the next was 2.6 percent and that of cumulative change over two quarters (6 months) was 4.6 percent. The corresponding figures for lags of 3 and 4 quarters were 6.4 and 8.3 percent respectively. If the economic forecaster allowed correctly for the postwar upward trend in income, these deviations would be reduced to 2.0, 3.2, 4.1 and 4.7 percent for lags of 3, 6, 9, and 12 months respectively. The average short-run variability of disposable income during 1929-37 was nearly twice as great (on a percentage basis) as the postwar variability without adjustment for trend.

The BAE outlook forecasts of disposable income a year ahead have come out within 2 or 3 percent in 4 of the last 6 years. The 1947 outlook statement underestimated the inflationary trend into 1948 and the October 1949 statement, of course, did not anticipate Korea.

We can use Equations (2) and (3) to show how the level of price-forecasting error is reduced as the accuracy of our estimates of the demand

[5] Clough, Malcolm, "Changes in Corn Acreage and Production After Early Indications," *Agricultural Economics Research*, Vol. III, No. 4, October 1951, pp. 145-146.

[6] Breimyer, Harold F., "Forecasting Annual Cattle Slaughter," *Journal of Farm Economics*, Vol. XXXIV, No. 3, August 1952, pp. 392-398.

and supply variables increases. On the average, the latter estimates improve as we draw nearer to the date to which the price forecast applies. At any given time (t) we may define an error for Equation (3) which corresponds in concept to the standard error of estimate. This error, in squared form, may be written

$$\sigma_{x_1'(t)}^2 = \sigma_{d_1}^2 + b_0^2\sigma_{\delta_{2(t)}}^2 + c_0^2\sigma_{\delta_{3(t)}}^2 \tag{4}$$

assuming no correlation between $\delta_{2(t)}$, $\delta_{3(t)}$, and d_1.

Remembering that S, the standard error of estimate, equals σ_{d1}, we can convert Equation (4) into a relative error, dividing through by S^2 and taking square roots as follows:

$$\frac{\sigma_{x_1'(t)}}{S} = \sqrt{1 + \left(\frac{b_0^2\sigma_{\delta_{2(t)}}^2 + c_0^2\sigma_{\delta_{3(t)}}^2}{S^2}\right)} \tag{5}$$

where (t) identifies the date on which the forecast is made and $\sigma_{\delta_{2(t)}}$ and $\sigma_{\delta_{3(t)}}$ are standard deviations of the differences between forecasts of (say) production and disposable income made on that date in earlier years and the final estimates of their values prevailing on the date to which the predicted price outcome applies. (For example, using Clough's figures on early season production indications for corn, $\sigma_{\delta 2(t)}$ would be 314 million bushels as of July 10, 178 million as of August 10, 107 million as of September 10, and so on.) Equation (5) expresses the error range in price forecasts made at time (t) as a ratio to the standard error of estimate—a ratio always greater than or equal to 1.[7]

For illustration, consider a schematic application of Equation (5) to corn, using rounded figures based on corn production as X_2 and a demand factor with forecasting accuracy about equal to the postwar variability of disposable income as X_3. We assume $b_o = -2$, $c_o = 1$, and $S = 18$ percent. We wish to estimate how the accuracy of forecasts of November-

[7] Strictly speaking, this ratio should be defined in terms of the standard error of forecast. When the variables are expressed as first differences, the terms in Equation (2) which depend on departures of the independent variables from their means (i.e., their mean year-to-year changes during 1922-41) are frequently small, and the standard error of forecast is little larger than the standard error of estimate. This is seldom true of equations based on original arithmetic or logarithmic values and is by no means always true of first difference equations either. If the standard error of forecast were used in the denominator of Equation (5), the standard error of forecast would also be substituted for σ_{d1} in Equation (4). The resulting error ratios would still be greater than or equal to 1 but (except at the lower limit) would be somewhat smaller than those based on the standard error of estimate.

May average corn prices will tend to improve as the season approaches, starting from the preceding December. The picture is roughly as follows:

Date at which price forecast is made	Standard errors of:		Standard error of forecasts of November-May average corn prices	
	Production forecasts ($\sigma_{\delta_2(0)}$) (percent)	Demand forecasts ($\sigma_{\delta_2(0)}$) (percent)	Actual (percent of expected price)	Relative to standard error of estimate
	(1)	(2)	(3)	(4)
Previous December	20	9	45	2.49
July	10	6	28	1.53
August	6	5	22	1.23
September	4	4	20	1.12
October	2	3	19	1.04
November	1	3	18[8]	1.02
December	0	2	18[8]	1.01

The reduction in price forecasting errors for corn as the season progresses is due mainly to improvements in the advance estimates of corn production. The July crop report greatly reduces our uncertainty about December corn prices, but the error band is still some 50 percent larger than the assumed standard error of estimate. For livestock products, the

[8] The use of an 18 percent error level for price forecasts made only two or three months in advance of the center of the November-May period may seem unrealistic, particularly for a storable commodity such as corn. The stabilizing effect of price supports is obvious, but even under free market conditions we rarely experience changes of 18 percent in corn prices (other than seasonal) within a two month period.

This raises some interesting questions. For example, the analysis from which the 18 percent standard error was obtained used only three independent variables—feed grain supplies, livestock numbers, and livestock prices—all on a national aggregate basis. Actually, numerous other factors are involved in the determination of corn prices—export demand, the geographic distribution of corn supplies and livestock numbers, the internal composition of feed concentrate supplies by type of feed, the amount, quality and distribution of hay, pasture and range feeds, the distribution of total grain-consuming animals units between specific classes of livestock, the severity of winter weather conditions, and so on. These factors are brought together in the market place, and their influence, if it could be measured statistically, might eliminate a large part of the 18 percent error range which remains after the simpler aggregative analysis. If the values of these variables in November resulted in corn prices 20 percent below the level expected from our simplified analysis, the persistence of some of these factors during the next two or three months would continue to hold corn prices below the regression estimate.

Hence, another line of research in practical price forecasting lies in measuring the week-to-week and month-to-month variability or inertia of prices themselves. For very short-term forecasts the assumption that corn prices will remain the same probably leads to much less than an 18 percent error range. However, the "inertia" approach to forecasting should be supplemented with a rather careful appraisal of the real factors whose persistence would justify price stability. There is always the possibility that the market at a given moment is out of line with all such factors—as evidenced by the dramatic price adjustments which occur from time to time.

relative importance of improvement in demand forecasts would be considerably greater.

More empirical work is needed to determine the accuracy with which prices of specific commodities can be forecast at various dates in advance of given "outcome" periods. One possibility would be to calculate the regression of actual prices upon the production and income forecasts existing at each crop reporting date. The net regression coefficients (and even the list of independent variables) might vary from one reporting date to another. As a measure of the improvement of forecasts over time we could compare the standard errors of estimate from the regressions for different reporting dates with each other and with the standard error of estimate obtained by relating prices to the final estimates of the independent variables. For forecasts one to three months in advance of the outcome date, actual prices during the month immediately past might be included in the forecasting equation, with the hope of taking advantage of any inertia that might exist in price-making forces other than those explicitly used in the basic equation.

In concluding this section, one other point should be noted. There may be errors of estimation or measurement in the final figures on price, production and income. To the extent that these errors in the different variables are not correlated with one another the coefficient of multiple determination will be reduced; also, if the errors lie in the independent variables the net regression coefficients will tend to be biased toward zero. Thus, improvements in the accuracy of basic statistical series can increase the accuracy and usefulness of the forecasts based upon them.

Other Factors Affecting the Accuracy of Price Forecasts

The discussion so far has considered forecasting errors in cases where some specified statistical demand function is known or believed to apply. In practice, we are never completely sure that the structure of economic forces playing upon a commodity price in some future year is exactly the same as during the historical period for which a demand function has been fitted. A close study of the conditions of production and distribution of the commodity may either make us confident that the structure has not changed materially or it may strongly suggest that the structure has changed.

Forecasts may be affected by a sudden growth in magnitude of variables the influence of which was previously small. The unprecedented accumulation of liquid assets—particularly cash and demand deposits—in the hands of consumers evidently had a great deal to do with the inflated demand for food during 1945-48. The influence of this factor during 1922-41 was probably small, and in any event there were no reliable statistics with which to measure it. Extreme changes in disposable income and

in the supply of a given product may take us onto a hitherto unexplored segment of the demand curve in which the elasticities previously experienced do not apply. For example, extremely high prices for a given commodity may lead to a more extensive substitution of competing commodities than would have been estimated on the basis of "normal" relationships.

Changes in the demand and supply structure.—Forecasts may also go wrong because of true changes in structure—that is, irreversible changes in the net relationships between the price of a commodity and various supply and demand factors. Some changes may arise from trends in consumer tastes. More sudden changes may occur, as when a commodity formerly sold only in fresh form develops a substantial processing outlet. This probably happened to cranberries after 1937, and possibly to oranges during and after World War II. In the first years of such a change the forecaster must apply judgment; in later years the relationships may become subject to statistical measurement. However, the structure of relationships now includes two or three demand curves instead of the original one.

Export commodities have presented special forecasting difficulties since about 1933. Export demand has been subject to arbitrary shifts because of the actions of governments in importing countries. Hence the forecaster working with export crops, in addition to estimating the normal behavior of farmers and processors, must also try to outguess the policy officials of other countries.[9]

Parenthetically, it is worth noting that producers of the major United States export crops, cotton, wheat, and tobacco, have been among the strongest advocates of government price support programs. The combination of major uncertainties and arbitrary elements in export demand, coupled with highly inelastic demands for domestic consumption, made prices of these commodities inherently less stable and predictable than those of most other farm products after 1933.

Accuracy of forecasts from some prewar demand functions during the postwar period.—Table 3 shows, for some 30 price series, the sort of information which is needed to appraise the applicability of prewar regression analyses to the estimation of price changes during the post World War II period. Column 1 repeats, for selected price series, the 1922-41 standard errors of estimate listed in Table 1. The "error tolerance" of two standard errors of estimate has the following approximate significance: (1) If the demand-supply structure represented by a 1922-41

[9] Mathematically, government actions might be considered as changing certain coefficients of an export demand curve which is jointly involved with a domestic demand curve in determining the price of an export crop. Uncertainties regarding government actions could be interpreted as additional terms in Equation (4).

TABLE 3. SELECTED FARM AND FOOD PRODUCTS: DIFFERENCES BETWEEN ACTUAL YEAR-TO-YEAR PRICE CHANGES AND CHANGES ESTIMATED FROM 1922–41 REGRESSION EQUATIONS, UNITED STATES, 1946–1952

Item[1]	(1) Standard error of estimate 1922–41	(2) Error tolerance for single observations[2] (Col. (1) times 2)	Difference between actual price change from preceding year and change based on 1922–41 regression					
			1947	1948	1949	1950	1951	1952 Preliminary
			Percent of expected price					
Retail Prices								
All meat[3]	1.7	3.4	[4]41.9	−4.3*	−7.1*	0.0	−0.2	6.2*
Beef, choice grade[3]	2.9	5.8	[4]53.5	−1.1	−6.5*	2.1	−3.7	11.7*
Pork[3]	3.0	6.0	[4]28.2	−7.1*	−6.1*	−4.1	7.6*	−4.3
Lamb[3]	2.9	5.8	[4]19.7	0.0	−1.4	−3.6	−3.3	10.4*
Fluid milk and cream	2.7	5.4	[4]8.6	5.7*	−3.2	−6.2*	8.9*	4.5
Butter	5.3	10.6	[4]10.9	0.0	−11.9*	−5.2	6.4	4.4
Market margin relationships[5]								
All meat animals	6.5	13.0	−12.9	−6.7	0.9	−9.4	−3.4	−9.1
Cattle, choice grade	6.9	13.8	−11.5	−12.3	17.2*	−12.3	−6.2	−6.7
Hogs	12.4	24.8	[6]−29.5	−8.4	−6.2	−0.5	−4.7	−1.6
Lambs	7.6	15.2	−4.7	−7.1	−7.7	3.5	−2.5	−4.7
Milk for fluid use	2.9	5.8	1.2	−8.2*	−3.0	−0.9	−7.1*	−4.0
Butterfat	2.2	4.4	[6]−17.6	−3.8	−0.2	−1.4	−3.8	−2.7
Farm prices								
All meat animals	7.9	15.8	[4]25.0	−18.0*	−9.8	−1.4	5.2	−10.7
Cattle	6.3	12.6	[4]20.1	−13.9*	−6.2	5.4	0.9	−7.7
Hogs	14.8	29.6	15.6	−22.6	−15.9	−7.3	9.1	−12.9
Lambs	7.4	14.8	−9.4	−16.8*	−30.0*	−0.9	−11.0	6.2
Milk for fluid use[3]	3.4	6.8	6.4	−1.1	−7.3*	−8.0*	11.7*	3.4
Butterfat[3]	7.4	14.8	14.3	−13.3	−11.5	−4.3	−5.2	−5.0
Apples	6.7	13.4	−33.6*	0.5	−11.3	−0.5	0.0	17.5*
Peaches (excl. California)	16.6	33.2	−23.4	−3.4	−16.4	−0.2	3.5	16.1
Oranges	14.0	28.0	−32.7*	8.1	23.9	−10.9	−30.5*	—
Potatoes (total production)	16.3	32.6	−42.2*	−39.6*	−37.3*	−23.3	−38.9*	55.6*
Potatoes (production less Government purchase)	16.3	32.6	−2.5	−39.5*	−6.0	−32.6	2.6	55.6*
Onions	15.2	30.4	−7.5	−22.2	−13.9	−21.5	24.5	25.0
Hay	8.6	17.2	1.6	10.2	−8.6	−4.5	1.9	6.3
Corn	17.9	37.8	7.4	−18.2	17.8	26.2	−10.7	−9.2
Prices of other feeds relative to corn price								
Sorghum grains	12.3	24.6	−9.8	−0.5	18.3	−18.0	−1.8	24.7*
Oats	11.0	22.0	0.5	−1.8	−1.8	4.5	−1.8	−3.4
Barley	12.3	24.6	5.0	−5.8	−4.7	0.2	−1.4	7.2
Prices paid by farmers, all feed	5.3	10.6	1.2	5.2	6.4	−5.4	7.2	1.2

[1] Supply variables used in the underlying analyses are production unless otherwise noted.
[2] If the real economic relationships and the factors making for residual errors or disturbances are the same as in 1922–41, only 1 actual price in 20 would be expected to deviate from the regression equation by more than 2 standard errors of *forecast*. The figure in column 2 (2 standard errors of *estimate*) is slightly to considerably smaller than this, and deviations of larger size would be expected somewhat more frequently than 1 in 20.
[3] Underlying analyses include per capita consumption as supply variable.
[4] Prices in 1946 averaged materially below free market levels, due to price controls. Better 1947 estimates could be obtained by using 1941 (the last prewar observation, unaffected by price ceilings) as a point of departure.
[5] Basic analyses express farm price (or equivalent farm value) as a function of retail price.
[6] Apparent market margins during first half of 1946 were held down with the aid of subsidies; hence, farm prices in 1946 were abnormally high relative to retail prices.
* Difference greater than the "error tolerance" (2 standard errors of estimate) shown in column 2.

regression equation *and* the probability distribution of disturbances or residual errors still apply, only about 1 actual postwar price in 20 should deviate from that based on the regression equation by more than 2 standard errors of *forecast*. As the standard error of estimate is always smaller than the standard error of forecast, the "error tolerance" in

Column 2 is somewhat too small to represent the 1 in 20, or 5 percent, probability level. In other words, even if the prewar measures were strictly applicable, we should expect somewhat more than 1 observation in 20 to deviate from the regression equation by more than the percentage shown in Column 2.

For most livestock products, the actual retail price increase from 1946 to 1947 was much greater than that indicated by the corresponding changes in supply and consumer income. The reasons for this are obvious. Retail prices through June 1946 had been held at 1942-43 levels by price ceilings, in the face of a great increase in consumer income and an unprecedented accumulation of ready cash by private individuals. With the removal of price ceilings in the second half of 1946, prices rapidly soared to the levels actually justified by both normal and abnormal demand factors. Other deviations in retail meat prices which exceeded the "error tolerance" occurred during 1948-49, apparently reflecting a lag in readjustment to the sharp price and income changes of 1946-47. The disturbance for pork in 1951 probably was due in part to the shortage of beef at ceiling prices.

Retail prices of Choice grade beef in 1952 averaged a shade higher than in 1951, despite a 10 percent increase in per capita consumption of beef. However, beef prices in 1951 had been held below the free market level whereas the increased 1952 supplies had completely eliminated pressures against price ceilings by the end of the year. Moreover, prices of the lower grades of slaughter cattle dropped sharply from 1951 to 1952 both in absolute level and relative to prices of Choice grade steers. Wholesale prices of Choice steer beef at Chicago dropped 2.46 cents a pound between the two years, while Commercial steer beef dropped 6.44 cents. These figures suggest that the over-all average retail price for beef (all grades) declined significantly relative to the published retail price series which refers to Choice grade only. A more comprehensive retail price series, if available, would be more nearly commensurate with the beef consumption variable and would probably be less affected by shifts in the relative supplies and prices of different grades of beef.

The movement of milk prices in 1950 and 1951 can be attributed in part to the release of price support stocks of dairy products, which delayed for several months the normal response of dairy product prices to the increase in demand following Korea.

The "market margin relationships" are equations expressing the farm prices or equivalent farm values of each product as functions of their retail prices. The 1947 deviations for hogs and butterfat may be partly due to the removal of processor subsidies in mid-1946, causing an unusual widening in the apparent marketing margins. Even in other years, the actual farm prices are predominantly lower than the regression estimates.

This probably reflects the continued widening of market margins which persisted even after farm and retail food prices had started to decline from their postwar peak. It is possible, also, that the logarithmic coefficients for 1922-41, when the farmers' share of the retail food dollar was relatively low, involve some distortion in the postwar years when the farmers' percentage, particularly for livestock products, was considerably higher.

The behavior of farm prices reflects disturbances both in consumer demand and in marketing margins. In some cases these reinforce each other, and in other cases they are partially offsetting.

Fruit prices were extremely high in 1946. The sharp drops into 1947 suggest that inventory demand for processed fruit may have been an important factor in 1946 which was absent, or abnormally low, in 1947. Potato prices based on total production are "out of bounds" in 5 years out of 6. When Government price support purchases are subtracted, the pattern of deviations is changed considerably, and only 2 of the 6 residuals exceed 2 standard errors of estimate. However, the persistence of these 2 large residuals suggests that there may have been real changes in the relationship between potato production and prices since 1922-41. Price ceilings on the 1951 potato crop were partly responsible for the unexpectedly large increase in prices for the 1952 crop. The 1951 crop was used up much earlier than usual, and the extreme shortage of storage potatoes in April and May of 1952 created a vacuum (and a speculative atmosphere) which resulted in extremely high prices during the early months of the 1952 marketing season. By February 1953, prices of 1952-crop potatoes were much below those of a year earlier, as would be expected from the larger 1952-crop production. Prices of onions, hay, and corn stayed well within bounds in each of the postwar years.

When expressed as functions of the price of corn, prices of oats and barley show perhaps abnormally small price variation. This may be due to the stabilizing effects of price supports for these grains set at fairly uniform relationships to the loan rates for corn. The disturbance in sorghum grain prices in 1952 was associated with the smallest sorghum crop since 1939.

The residuals shown in table 3 would justify much more intensive analysis than has been given here. Sharp alternations in the signs of large residuals might in some cases be traced to fluctuations in inventories, or at least in inventory demand. More exacting tests could be applied in searching for changes in demand structures. For example, a sequence of 4 or 5 negative deviations of moderate size, as in several of the "market margin relationships," can be shown to indicate with high probability a downward shift in the function relating farm to retail prices. To show that the prewar model still applies, it is necessary not only that the in-

dividual residuals be of moderate size but that there be random variations in sign.

On the whole, the prewar regressions seem to have held up fairly well. Some of the larger deviations can be explained by known disturbing factors, such as the imposition or removal of price controls. Other large deviations suggest that improvements are needed in the basic estimating equations, including refinements in the individual series used and allowances for additional variables. Still others may be due to changes in structure which will require more drastic revisions of the 1922-41 analyses. However, I think most analysts would agree that the years shown, including postwar decontrol, inflation, readjustment, and the post-Korea inflation with scattered price controls, constitute an unusually severe trial for any "normal" forecasting relationship.

Methods of Improving the Accuracy of Price Forecasts

Where full use has not been made of existing data, the first step may be to exploit the remaining possibilities by means of statistical analysis. This analysis can be guided and made more fruitful by more careful *economic* analysis of the factors affecting consumer behavior, the behavior of marketing agencies, and the behavior of producers with respect to the commodity in question. This economic analysis may well be formalized into a chart or diagram of the structure of economic forces involved in price determination for the commodity. Every element of the structure should "make sense" in terms of the profit objectives or policies of the economic agents involved, the degree of competition in the various markets, and the cost functions and technological characteristics of farms, processing firms, and distributing agencies.

Within such a structure, statistical measurement should be made of those relationships—at least the major ones—for which satisfactory data are available and which can be "identified." In many cases, I believe that this approach can be made to yield formal statistical estimating devices which will give more accurate forecasts than those of a largely intuitive commodity specialist. The possibilities of existing data can also be further exploited in connection with seasonal change, inventory fluctuations, and other phenomena of a year or less in duration.

Beyond this, the economic relationships between price and other factors may be further refined and illumined by the development of new data, as on inventories at previously unreported market levels. There is a possibility, of course, that the availability of new price-forecasting information will cause marketing firms to alter their behavior to some extent and to make at least a minor change in the structure of economic forces affecting price.

Price forecasts can also be improved by improving our forecasts of the "independent" variables such as production and disposable income. If weather could be forecast with better than random accuracy for several months to a year in advance, this knowledge would be superior to the universal assumption of "average growing conditions for the remainder of the season" which underlies current crop forecasts.

Forecasts of disposable income and consumer expenditures may be improved, at least in most years, by the convergence of various lines of research, including inter-industry economics, sample surveys of consumer buying intentions, and other types of information. However, forecasts for a year or more in advance can always be disrupted by a "Korea" or an even more serious outbreak. There may be a probability calculus applicable to such events, but it is not generally the property of economists.

Concluding Remarks

This article has presented some basic problems of price forecasting from a more formal statistical viewpoint than those adopted by Baker, Paarlberg, and Cavin. Factors affecting the accuracy of price forecasts were shown to differ widely in magnitude from commodity to commodity. The over-all forecasting problem was broken down into specialized sub-problems, as (1) forecasting crop and livestock production; (2) forecasting disposable income and other demand factors; (3) measuring the net effects of production, income and other factors (in terms of actual values or final estimates) upon price; and (4) the recognition of new situations, such as the emergence of hitherto unmeasured or unimportant variables, and major changes in utilization or in the basic responses of domestic or foreign purchasers. The postwar performance of a number of 1922-41 price-estimating equations was also discussed.

In conclusion, I should like to give one more answer to the frequently raised question, "Is forecasting a science or an art?" Differences over this question often lie more in terminology than in substance. The forecaster who emphasizes "art" may subsume under that term a great many rules of thumb and approximative relationships which were based originally on economic or statistical analysis. He may differ from the self-consciously "scientific" forecaster mainly in the extent to which he relies on mental arithmetic rather than a calculating machine.

My own feeling is, that considerable progress in forecasting can be made by the application of formal statistical methods. This leads me to emphasize the role of "science" in economic forecasting. If an "artist" in this field makes a statistically significant improvement over the best formal or "scientific" forecasting devices now in use, I am inclined to look for, and if possible quantify, the additional (and evidently relevant)

factors which are used consciously or implicitly to produce this result. There are methods and principles by which science advances, and statistical measures by which the significance of reputed advances can be tested. These methods, principles, and measurements can be passed on to future forecasters. I know of no sure method for transmitting an "art" from one forecaster to another; if a successful transmission is accomplished, the "art" itself must be basically susceptible to quantitative or statistical procedures.

AN EXPERIMENT TO DERIVE PRODUCTIVITY AND SUBSTITUTION COEFFICIENTS IN PORK OUTPUT

EARL O. HEADY*, ROGER C. WOODWORTH*, DAMON CATRON**, AND GORDON C. ASHTON**
Iowa State College

SPECULATION on the role and use of basic concepts from production economics in physical and biological research has been at the forefront for sometime. Some few persons claim that no close relationship exists between these fundamental relationships and applicability to agriculture. However, the greatest number of persons has recognized the usefulness of the tools but has been unable to see any possibility of getting them incorporated into physical research because of lack of close cooperation between biological scientists and economists. In this paper we attempt to show three things, namely; (a) that tools from production economics can be used effectively in physical research (b) that animal nutritionists and production economists can work closely together in carrying on important research and (c) the procedures can improve the findings and recommendations of both animal and economic sciences to farmers. Our report is necessarily brief and we make no attempt to outline the full details and limitations of our procedures. The simple educational techniques which can be used to explain the results to farmers or program administrators are explained only briefly. A forthcoming research bulletin will cover both the technical and practical aspects of presentation as well as details on substitution ratios in relation to time, product price changes, variability of returns, labor costs and other factors relating to choice in the use of feed and other resources for pork production. In the summary which follows, we simply assume that the reader is acquainted with the terms as well as the proper use and adaptation of the data.

We hope that our efforts will show how fundamental research can be carried on co-operatively and effectively. We believe that too little has been accomplished in this direction in the past. Probably the greatest catalyst in increasing the amount of co-operative work is the research workers themselves and their ability to study and appreciate each others' field. This paper reports briefly a study set up in swine nutrition to provide statistics basic to economic analysis.

---

* Staff members in the Economics Department. ** Staff members in the Animal Husbandry Department. Journal paper J-2278 of the Iowa Agricultural Experiment Station, projects 1135 and 930.

The Problem

Our study deals with the nature of the production function or input-output relationship, including the rate at which feeds substitute for each other and the rate at which feed is transformed into meat, in pork production. These data are important to farmers in decisions on the most profitable ration, the optimum marketing weight and even on the number of hogs to produce. Changes in the relative price of feeds or in the price of feeds relative to pork necessitate that information on substitution rates and transformation ratios be available if pork production is to approach an economic optimum. These same data are important in choices relating to national production programs (i.e. wartime crop acreages, production control etc.). Our efforts are not based on idle curiosity nor are they, in the words of Poe, "for the sake of scrutinizing with a microscope" or the "dividing of a building into measured, square inches." They are based partly upon the requests of a group of farmers who suggested the Iowa Experiment Station should provide information to allow calculation of optimum rations under changes in feed price relatives such as those occurring in recent years; they are based partly on recognition that classical recommendations in swine nutrition (namely, that a single ration should be fed in the manner of fixed coefficients) has neither complete physiological nor economic base. Finally, they are based on the knowledge that during food emergencies, lack of data on corn/soybean substitution rates in the rotation and corn/protein substitution rates in the ration is a handicap in planning the most efficient use of resources at the national level. The development of vitamin B_{12} and antibiotics also have caused previous work on protein levels to be obsolete. Thus, since protein level data needed to be re-estimated under new feeding techniques, we decided to make these estimates in a logical fashion to allow a fuller use by farmers of their economic and nutritional aspect. Previous information on corn-protein rations never fully recognized the real nature of substitution. We hope to have made a contribution to science, as well as to farm profits, by helping to complete this void in knowledge.

Feeds Resources and Design

The experiment, conducted with the physical facilities of the animal husbandry department's swine farm, was designed to determine the production function or surface for hogs. The production function which is relevant is of the general form $Y = f(C, P, A, I, X_1, X_2 \ldots X_n)$ where Y refers to gain per hog after weaning, C refers to number 2 yellow corn, P refers to soybean meal with vitamin B_{12} and A refers to antibiotics in the form of aureomycin, the X's refer to labor, buildings or other resources available in either fixed quantities or quantities so great that they did

not limit the productivity of the feeds (or which are uncontrolled. The uncontrolled variables generate unexplained residuals to be handled with the probability *calculus* of statistics.) A final decision was to include only two levels of aureomycin input for the ration; namely, zero and 500 m.g. per 100 pounds of feed. Hence we simply work out two production functions; both with corn and protein as variable feeds while one is "with" and one is "without" aureomycin. Vitabin B_{12} content was 500 m.c.g. per 100 pounds of soybean oilmeal.

The hogs, Durocs and Durocs x Landrace x Poland crosses were started in the experiment at an average of about 40 pounds and carried to 200 pounds. Rations fed ranged from 10 to 20 percent protein. Other feeds than corn and soybean meal were held constant in the ration and included 3 pounds of bonemeal, .6 pounds of $CaCO_3$, .1 pound of trace minerals and 10 grams of vitamins (per 100 pounds of feed). While we recognized that our regression procedure would not require replication for comparison of "within" and "between" treatment variance, we did replicate the different rations in order that certain comparisons could be made with data from previous experiments. Our regression procedures provide the basis for similar estimates with many fewer hogs than normally used, particularly if they are fed individually, since we are not concerned with "within treatment" variance but only with the standard error of estimate for the regression coefficients. The current experiment included 192 hogs. Work in weighing, feeding and in keeping records for this number of hogs was done by individuals from both the animal husbandry and economics departments. The different groups of hogs were fed the same ration over the entire 40-200 pound weight interval. They were weighed every second week and gains and feed inputs were accumulated to provide input-output observations at varying points over the growth period.

Functions Used

Two types of equations have been fitted to the data (a) a Cobb-Douglas function which is a linear regression equation when fitted in logarithms and (b) a quadratic function, fitted in the original observations.[1] In order to allow more flexibility in our coefficients, we fitted these production functions to the three weight intervals 40-75, 75-150, and 150-200 pounds as well as to the over-all 40-200 weight interval. (Each interval equation has been computed in terms of the gains and feed inputs beyond the start of the interval and not from the weaning weight). This procedure was followed particularly since a single Cobb-Douglas function derived for

[1] For a discussion of the differences between the two general types of functions, see Heady, Earl O. *Use and Estimation of Input-Output of Productivity Coefficients*, Jour. Farm Econ. Proceedings. Vol. 34.

the overall data does not allow substitution rates to change as Y, output or gain per hog, increases; by fitting three functions to the three weight intervals, we obtain different substitution rates, "as an average" for the different intervals. We suppose that if we obtain substitution rates which serve "as an average" over a few gain intervals, we have as much refinement as farmers need in decisions.

In total (including three weight intervals and an overall function, a Cobb-Douglas and quadratic for each and "with" and "without" aureomycin), we have derived the sixteen production functions, predicting the interrelationships between carbohydrate and protein feed and pork output, outlined below. All but one of the coefficients shown below, for the Cobb-Douglas functions are significant at the one percent probability levels. The quadratic coefficients noted with two asterisks were not significant at the ten percent level of probability.[2] In presenting our data we include most of the basic equations. While we do not use all of them in this study, we present them for use of other research workers who may wish to use a specific one for a specific purpose or to examine the differences and difficulties inherent in the equations and procedures. Our tables and analysis illustrate how they can be used. The experiments are being repeated and in the absence of skin disease, a complexity encountered in the first experiment for the 75-150 pound interval, we will undoubtedly be able to lower our standard errors of estimate.

I. *Without Aureomycin*

A. Cobb-Douglas

(1a) 40-75 lb: $Y = 1.658C^{.464}P^{.357}$

(2a) 75-150 lb: $Y = .342C^{.938}P^{.063}$

(3a) 150-200 lb: $Y = .345C^{.888}P^{.096}$

(4a) Overall: $Y = 1.174C^{.657}P^{.179}$

B. Quadratic

(5A) 40-75 lb: $Y = 3.006 + 141C + 1.300P + .000635C^{2**} - .0182P^2 - .000902CP^{**}$

---

[2] We report only the results of one phase of our study here. The entire experiment was repeated during the summer months. We present data for the winter phase; in this experiment some of the hogs contacted skin disease. It appears, however, that results will be nearly the same for both experiments. If the two sets of data are pooled, all regression coefficients are significant at the 5 percent level of probability. Analysis of additional data from later experiments show the protein coefficients to decline and the corn coefficients to increase with hog weight for Cobb-Douglas functions computed for different weight intervals. This relationship is consistent with the biological need for less protein for growth and more carbohydrate for fattening as the hog progresses in weight.

** refers to coefficients which do not differ significantly from zero at the 10 percent level of probability.

(6a) 75-150 lb: $Y = -7.478 + .444C + .0617P^{**} - .000501C^2 + .000125P^{2**} - .000069CP^{**}$

(7a) 150-200 lb: $Y = -2.107 + .314C + 161P^{**} - .000469C^2 - .00255P^2 + .00114CP^{**}$

(8a) Overall: $Y = 2.815 + .318C + 348P - .000108C^2 - .000665P^2 - .000118CP^{**}$

II. *With Aureomycin*

A. Cobb-Douglas

(9a) 40-75 lb: $Y = 1.445C^{.547}P^{.289}$

(10a) 75-150 lb: $Y = .555C^{.795}P^{.151}$

(11a) 150-200 lb: $Y = .467C^{.796}P^{.161}$

(12a) Overall: $Y = 1.360C^{.630}P^{.201}$

B. Quadratic

(13a) 40-75 lb: $Y = 1.508 + .299C + 854P - .00049C^{2**} - .0107P^2 + .00172CP^{**}$

(14a) 75-150 lb: $Y = -4.956 + .365C + .364P - .000279C^2 - .000796P^{2**} - 4.956CP^{**}$

(15a) 150-200 lb: $Y = .827 + .242C + .220P^{**} - .000289C^{2**} - .0053P^2 + .00286CP$

(16a) Overall: $Y = 2.032 + .324C + .464P - .000129C^2 - .000917P^2 - .000111CP^{**}$

From these equations it is possible to define the marginal or additional product forthcoming from an added pound of one feed when either (a) the other feed is increased in the same proportions or (b) the other feed is held constant at a fixed amount. As examples, we have the two equations below (the first for the Cobb-Douglas and the second for the Quadratic equation) for the overall function with aureomycin; as derivitives, they show the marginal rate of transforming corn into pork when

$$\frac{\partial Y}{\partial C} = \frac{.857P^{.201}}{C.370}$$

$$\frac{\partial Y}{\partial C} = .3243 - .000111P - .00026C$$

protein is fixed at different levels. These marginal product equations, like those for every other function fitted, show declining marginal productivity of one feed alone or the two in combination as hog weight increases. This point is evident in the Cobb-Douglas functions for example, since the logarithmetic regression coefficients (the exponents in the production function equations above) are the production elasticities and all are less than 1.0; also the sums of the coefficients are all less than 1.0. Therefore, a 1.0 percent increase in feed input is accompanied by

TABLE 1. TOTAL GAIN AND MARGINAL GAIN FOR DIFFERENT FEED LEVELS WITH RATIONS IN FIXED PROPORTIONS; THREE PROTEIN LEVELS WITH AND WITHOUT AUREOMYCIN (GAIN OVER BEGINNING WEIGHT OF 40 POUNDS)

Total feed per hog	w. aureomycin[a]		wo. aureomycin[b]		w. aureomycin[a]		wo. aureomycin[b]	
	log.[c]	quad.[d]	log.[c]	quad.[d]	log.[e]	quad.[f]	log.[e]	quad.[f]
				12 percent protein				
50	20	18	19	18	—	—	—	—
100	36	34	34	33	.316	.312	.293	.294
150	51	49	48	47	.290	.300	.273	.285
200	64	63	60	61	.273	.289	.258	.275
250	77	77	73	74	.262	.277	.248	.265
300	90	90	85	87	.253	.266	.240	.255
350	102	103	96	99	.247	.254	.233	.245
400	114	115	108	101	.140	.241	.228	.235
450	126	127	119	122	.235	.237	.228	.228
500	138	138	130	133	.231	.219	.219	.216
550	149	148	141	143	.227	.207	.216	.206
600	160	158	151	153	.224	.199	.212	.196
650	171	167	162	162	.221	.181	.209	.186
700	182	176	172	171	.218	.172	.207	.176
750	193	184	182	179	.215	.161	.204	.166
800	204	191	193	187	.213	.149	.202	.156
				14 percent protein				
50	21	19	19	18	—	—	—	—
100	37	35	35	33	.326	.319	.303	.295
150	52	50	48	47	.298	.306	.278	.285
200	66	65	62	61	.282	.294	.263	.274
250	80	79	74	74	.269	.281	.252	.263
300	93	92	86	87	.261	.269	.244	.253
350	105	105	98	99	.253	.256	.238	.242
400	118	117	110	110	.248	.244	.232	.232
450	130	129	121	121	.242	.231	.227	.221
500	142	140	132	132	.238	.218	.223	.211
550	153	150	143	142	.234	.206	.219	.200
600	165	160	154	151	.230	.193	.216	.190
650	176	168	165	160	.227	.181	.213	.179
700	188	177	175	169	.224	.168	.211	.169
750	199	185	186	177	.221	.155	.208	.158
800	210	192	196	184	.219	.143	.206	.147
				16 percent protein				
50	21	19	19	18	—	—	—	—
100	37	35	34	33	.327	.324	.303	.305
150	52	51	48	47	.299	.310	.278	.284
200	67	65	61	61	.283	.296	.263	.272
250	80	85	74	74	.271	.282	.252	.261
300	93	93	86	86	.262	.269	.244	.249
350	106	106	98	98	.255	.255	.237	.238
400	118	118	110	109	.248	.241	.232	.226
450	130	129	121	120	.244	.227	.227	.215
500	142	140	132	130	.239	.213	.223	.203
550	154	150	143	140	.235	.199	.218	.192
600	166	159	154	149	.231	.185	.216	.180
650	177	168	165	157	.229	.171	.213	.169
700	188	175	175	165	.225	.158	.210	.157
750	200	183	185	173	.222	.143	.208	.146
800	211	189	196	179	.220	.130	.205	.134

(Footnotes at bottom of page 347)

a gain of less than 1.0 percent. (We believe our additional research will provide more consistency for the interval functions.) For example, in the first "overall" function without aureomycin, a *one* percent increase in corn will increase gain by .657 percent while a one percent increase in both feeds will increase gain by .836 percent (.657 plus .179). In Table 1 below, we show the derived input-output relationship for the Cobb-Douglas and quadratic overall functions "with" (equations 12a and 16a) and "without" (equations 4a and 8a) aureomycin when the ration is held constant at a two protein level; columns 5-9 show the added or marginal gain, computed by arithmetic, for each added pound of the "fixed" feed combination. The difference between columns can be imputed to the aureomycin. These figures correspond to the *scale line* in economics because the two feed resources are held in constant ratio as input and output are increased. By presenting these data relating to output-input, we do not infer that farmers should feed hogs a constant ration over-all weight intervals. As we show later, substitution ratios change with weight and the least-cost ration will also change with

TABLE 2. CORN PRODUCTIVITY WITH PROTEIN FIXED AT TWO LEVELS, LOGARITHMIC, OVERALL FUNCTION WITH AUREO

Gain with 52 lb. protein			Gain with 110 lb. protein	
Total corn input	Total gain	Marginal gain per lb. feed[a]	Total gain	Marginal gain per lb. feed[a]
lb.	lb.	lb.	lb.	lb.
50	35	.44	40	.52
100	54	.34	62	.40
150	69	.29	81	.34
200	78	.27	97	.31
250	95	.24	111	.28
300	107	.23	125	.265
350	118	.21	137	.25
400	128	.20	150	.24
450	138	.19	161	.23
500	148	.185	172	.22
550	157	.18	183	.21
600	166	.175		
650	174			

[a] Computed as derivatives and refer to marginal gain with feed input "at" the level indicated. All gains are above the 40 lb. beginning weight. Computed from the overall logarithmic function.

[a] With aureomycin.
[b] Without aureomycin.
[c] Computed from the total product or production function equation using logs.
[d] Computed from the same data except for use of a quadratic equation.
[e] Computed by arithmetic as the difference between the corresponding total weights from the logarithmic functions.
[f] Computed by arithmetic as the difference between corresponding total weights from the logarithmic functions. Weights beyond 200 pounds are extrapolations outside range of observations. Estimates are made from the overall logarithmic function.

weight. The data of Table 1 are presented as one relationship of interest to both economists and animal nutritionists. Figure 1 shows the input-output curves derived from the Cobb-Douglas equation.

In Table 2 we present the marginal products for corn with protein "held constant" at two levels. In contrast to Table 1 where both feeds were varied and held in constant proportions, we now have varied only corn while protein is fixed (in the sense of feeding a given amount of it over the production period.) In a purely "residual manner," the differences in total and marginal products for any given "corn input" are due to the differences in protein levels. We have derived these data for the overall-aureomycin curve from the logarithmic function.

Substitution Equations and Contours

From each of the previous production functions we are able to derive a feed-combination or iso-product equation. With Y, gain per hog, set at different levels, these equations can be used to derive all possible combinations of the two feeds which will produce a given gain per hog.

I. Without Antibiotics (Cobb-Douglas Only)

(1b) 40-75 lbs: $C = \left(\frac{Y}{1.658P^{.357}}\right)^{2.16}$

(2b) 75-150 lbs: $C = \left(\frac{Y}{.342P^{.063}}\right)^{1.07}$

(3b) 150-200 lbs: $C = \left(\frac{Y}{.345P^{.096}}\right)^{1.13}$

(4b) Overall: $C = \left(\frac{Y}{1.169P^{.179}}\right)^{1.52}$

II. With Antibiotics (Cobb-Douglas Only)

(9b) 40-75 lbs: $C = \left(\frac{Y}{1.445P^{.289}}\right)^{1.83}$

(10b) 75-150 lbs: $C = \left(\frac{Y}{.555P^{.151}}\right)^{1.26}$

(11b) 150-200 lbs: $C = \left(\frac{Y}{.467P^{.161}}\right)^{1.26}$

(12b) Overall: $C = \left(\frac{Y}{1.360P^{.201}}\right)^{1.59}$

These equations listed below for the logarithmic functions are derived from the corresponding production functions, allow derivation of quantity

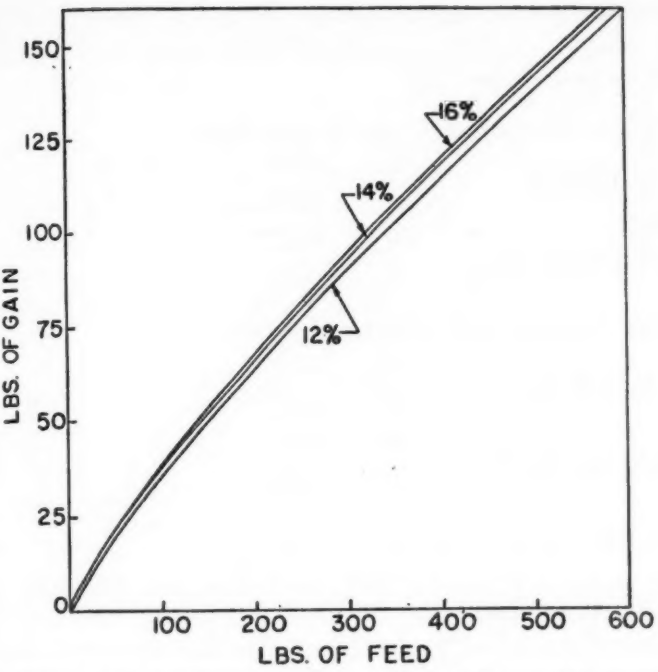


FIG. 1—TOTAL GAIN FOR RATIONS FIXED AT 12%, 14% AND 16% PROTEIN, WITH AUREOMYCIN, LOGARITHMIC FUNCTION. FEED QUANTITIES ARE THOSE NECESSARY TO PRODUCE 100 POUNDS OF GAIN AT THE WEIGHTS SPECIFIED.

of corn (C) necessary to produce a given pork output per hog (i.e. Y in the equation set at the desired level of gain) when the quantity of protein (P) in the equation is set at different levels. These quantities provide the iso-pork schedules or contours for determining the least-cost ration i.e. they show all possible combinations of corn and supplement which will produce a specified gain.

Marginal Rates of Substitution

While the product contour equations and quantities show the amounts of feeds necessary for producing any stated amount of pork, it is the marginal rates of substitution which provide the "quick key" to least-cost rations. The product contour or pork isoquant feed schedules are the basis for calculating the costs of the many possible rations for producing a given amount of pork. The marginal substitution rates indicate immediately, however, the ration which gives the lowest feed cost; when the ratio obtained by dividing the price of protein feed by the price of corn (the corn/protein price ratio) is equal to the rate at which protein substitute for corn ($\Delta C/\Delta P$ or the corn/protein substitution ratio), the minimum cost ration has been attained. We provide the substitution equations

below for the Cobb-Douglas function. These are obtained as derivitives from the contour equations in the last section for two weight intervals, with and without aureomycin.

I. Without Aureomycin (Cobb-Douglas Only)

(1c) 40-75lbs: $$\frac{\partial C}{\partial C} = \frac{.357C}{.404P}$$

(2c) 150-200 lbs: $$\frac{\partial C}{\partial P} = \frac{.096C}{.888P}$$

II. With Aureomycin (Cobb-Douglas Only)

(9c) 40-75 lbs: $$\frac{\partial C}{\partial P} = \frac{.289C}{.547P}$$

(10c) 150-200 lbs: $$\frac{\partial C}{\partial P} = \frac{.161C}{.796P}$$

Function Selected and Substitution Ratios.

As the reader will quickly note, similarities and differences exist for the two functions fitted. They tend to be similar over the middle of the ranges indicated and to differ considerably at the extremes of the observations. This difference is caused by the nature of the equations themselves. The Cobb-Douglas function causes the iso-product contours to become asymptotic to the axes while the quadratic function allows them to intersect the axes (if sufficient observations exist and the estimates are derived for three extremes.)[3] Selection of a function in this case, since there is no direct statistical test, must depend largely on the underlying "subject matter logic." If we had to select a *single* "overall" function, we likely would select the quadratic since it allows substitution rates to change as the hog attains heavier weights; the Cobb-Douglas does not.[4] However, since we can derive different functions for different weight intervals with the Cobb-Douglas (and thus allow changes in substitution rates for hogs of different weights) we tentatively choose to use this function; it is more nearly consistent with protein as a limitational factor (i.e. some small amount is necessary if the hog is to reach market before death from "old age"). Additional analysis of our data may lead us to other conclusions in respect to appropriate functions.

[3] While all the details are not presented here, they can be found in Heady, *Use and Estimation of Productivity Coefficients.* Jour. Farm Econ. Vol. 34.

[4] We will have forthcoming bulletins giving (1) more details on the particular functions, feed combinations and substitution rates which appear most nearly acceptable (logical). (2) the complete and fundamental economic analysis of the hog rations, including the nature of the output expansion path, and (3) the practical presentation of the findings.

TABLE 3. FEED COMBINATIONS AND MARGINAL RATES OF SUBSTITUTION OF PROTEIN FOR CORN FOR TWO HOG WEIGHTS. AUREOMYCIN INCLUDED IN RATION

60 pound pigs*				175 pound pigs**			
Feed for 100 lb. gain		% protein in ration	Marginal rate of substitution (lb. corn replaced by lb. protein)	Feed per 100 lb. gain		% protein in ration	Marginal rate of substitution (lb. corn replaced by lb. protein
Protein	Corn			Protein	Corn		
20	294	9.38	7.78	20	429	8.70	4.33
25	262	10.22	5.53	25	410	9.16	3.31
30	238	11.11	4.18	30	345	9.63	2.66
35	219	12.03	3.31	35	383	10.10	2.21
40	204	12.96	2.70	40	373	10.57	1.88
45	192	13.88	2.25	45	364	11.03	1.63
50	181	14.83	1.92	50	357	11.49	1.44
55	172	15.75	1.66	55	350	11.96	1.28
60	165	16.62	1.45	60	344	12.41	1.16
65	158	17.51	1.28	65	338	12.86	1.05
70	153	18.31	1.15	70	333	13.31	.96
75	146	19.22	1.03				
80	141	20.02	.93				

* Computed from the 40–75 pound interval function.
** Computed from the 150–200 pound interval function. Both functions are logarithmic.

The equations just presented indicate the amount of corn for which one pound of protein feed substitutes. We need only substitute in a particular combination of feed, as derived in the "b" equations for the pork isoquants, into our "c" equations and we predict the substitution rates (i.e. for the level of pork production and the particular ration specified). In Table 3 we present the derived food combination quantities and the substitution rates for hogs of two weights (i.e. two weight intervals). Although the equations themselves refer to a given gain per pig, we have converted these into a quantity of feed for a 100 lb. gain for specified hog weights as an aid in interpretation. (The hog weight indicated is the midpoint of each weight range and the feed quantities have been computed by setting Y at the gain necessary to attain this weight, beginning at the lower weight of the interval).

In Table 3 the first and second columns under each weight show numerous combinations of protein (including vitamin B_{12}) and corn which will produce the equivalent of 100 pounds of pork; the third column of substitution rates shows the pounds of corn replaced by one pound of protein "at exactly the feed combination shown." (Actually, in the sense of calculus, for any infinitely small change away from the specified feed combination.) It is our notion that, as a purely pragmatic measure, if we show feed combinations and substitution ratios for two or three weights of hogs, farmers can use these as "averages" or "benchmarks" for changing rations with hog growth or price ratio changes. While we

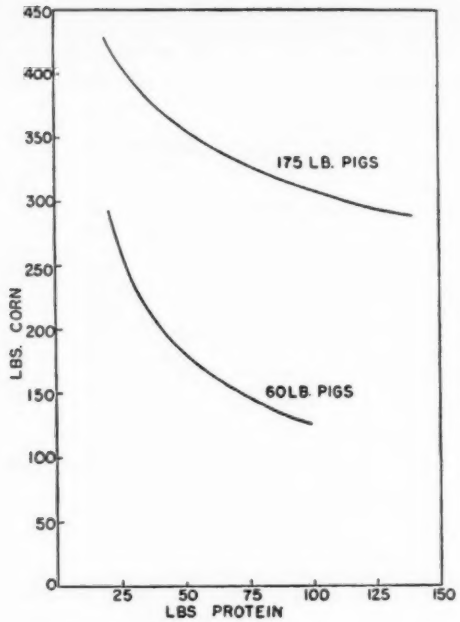


FIG. 2.—FEED COMBINATIONS FOR 60 AND 175 LB. PIGS, LOGARITHMIC FUNCTIONS WITH AUREOMYCIN.

could compute substitution ratios for each half-pound gain in hog weight, the farmer could not use this degree of detail and we think that, as a practical measure, some three or four "benchmarks" will provide the information needed. (Figure 2 shows the contours for the two same weights except that they are now shown as "gain beyond weaning.")

In general, aureomycin in the ration reduced the quantity of both feeds used per 100 pounds of gain. From this experiment we are unable to say whether the corn/protein substitution rate was greater or smaller with aureomycin in the ration. Our computed figures show it greater for the two upper intervals but smaller for the lower weight interval. Also, some of our contour lines without aureomycin intersected some of those with aureomycin. We hope that added data will increase the stability of our regression coefficients.

Presentation of Data

We mentioned that we were mainly interested in presenting the results of this production function study to report the effectiveness of co-operative research by animal scientists and economists. The field is "wide open" and "unexploited." But research has no great meaning until it is put into effect. The question then arises: How can such highly technical

data be presented to farmers and program administrators? Of course for economists we could simply say that the least cost ration is attained under the condition $\frac{\Delta C}{\Delta P} = \frac{P_p}{P_c}$ where $\frac{\Delta C}{\Delta P}$ is the marginal substitution rate of protein for corn and $\frac{P_p}{P_c}$ is the price per lb. of protein divided by the price per lb. of corn; least cost is attained when the substitution ratio is equal to the price ratio. But we can explain the same thing to the farmer in the simple manner of figure 3 below. The problem is not one of complexity of the procedure and principle in economic or nutrition research; it is one of getting extension personnel and journalists to present the basic subject matter in a simple manner. Agricultural economists often have missed the real point here. It is one of "presenting economic information" and not one of "getting information for economic analysis."

We have drawn the figure in the manner of a "clock face." The farmer need only point the hand at the price ratio (the bottom set of figures which represent different protein/corn price ratios) and the other end of the hand tells him the least cost feed ration for the two weights. (Actually the exact weights can be replaced by intervals and more can

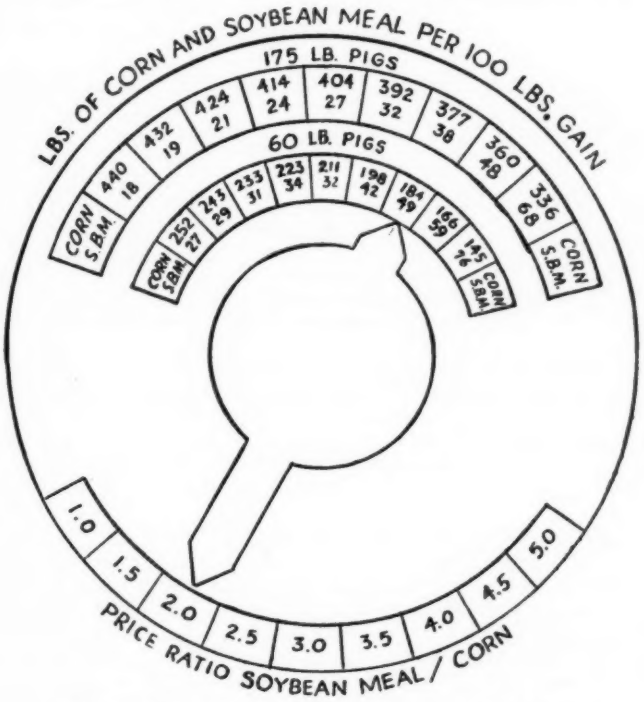


FIG. 3.—LEAST COST RATION FOR 60 AND 175 LB. PIGS.

be added.) We can have the farmer working calculus and he won't know it. (In final form the "protein clock" should be made of cardboard and include a durable hand so that it won't wear out so readily. We have other "presentation plans" too difficult to picture here, but simple in method. One may show, on the other side, the necessary selling price to break even given present weights and pork, protein and corn prices.) Economic principle can be extremely simple and attractive for farmers to work out, if we choose to make them so.

Again we remind the reader that our presentation does not include time, pork price and other considerations. Daily rate of gain may be "all important" under price uncertainty as seasonal price differentials. Neither have we been able to discuss all of the "quirks" in our many equations. We have shown, however, the product of some cooperative research by nutritionists and economists. The presentation provides a base for extending and improving the work at other schools. Also, we will dig deeper into price, time, gain rate, and statistical aspects of the problem in a more detailed publication. We also are making a study of carcass composition under the different rations.

AN EMPIRICAL STUDY OF PRICE EXPECTATIONS AND PRODUCTION PLANS*

WILLARD F. WILLIAMS**
California State Department of Agriculture, Bureau of Markets

IN THE economic world expectations are a link between the present and the future, and they are one of the keys to study processes by which decisions are made. In recent years economists have been increasingly interested in business expectations, decision-making processes, and economic effects of uncertainty, but few economists have attempted thorough studies of these problems. The few empirical investigations made in recent years have been limited in scope and exploratory in nature.[1] Even theoretical formulations of these problems, nonstatic theories of the firm, are neither complete nor well integrated.[2] However, the present state of economic dynamics suggests some of the pathways by which statistical investigations should proceed.[3] Such investigations, in turn, may contribute to development of more refined theoretical models.

This study was another exploratory investigation in which certain postulates concerning economic expectations and uncertainty were tested and evaluated in the light of considerations relevant to the dairy industry.

---

* For a more complete and comprehensive report of this study see: Willard F. Williams, "Short-Run Expectations: An Analysis of Price and Production Expectations and Plans of Southwestern Indiana Dairy Farmers," unpublished doctoral dissertation, Purdue University, 1952. This study was financed by the Purdue (University) Research Foundation.

** The author is indebted to Dr. Norris T. Pritchard, Bureau of Agricultural Economics (formerly Purdue University), for his criticisms of this paper and for his assistance in planning and conducting the study. Professors Don Paarlberg and E. L. Butz, Purdue University, among others, assisted in planning surveys and in reviewing the analysis. The author also acknowledges the constructive aid of Professor Sidney Hoos, University of California, in the development of this paper.

[1] Studies carried out during recent years and concerned with farmers' expectations and plans include T. W. Shultz, and O. H. Brownlee, "Two Trials to Determine Expectation Models Applicable to Agriculture," *Quarterly Journal of Economics*, Vol. LVI, May 1942, pp. 487-96; O. H. Brownlee and W. Gainer, "Farmers' Price Anticipations and the Role of Uncertainty in Farm Planning," *This Journal*, Vol. XXXI, No. 2, May 1949, pp. 266-76; D. B. Williams, "Price Expectations and Reactions to Uncertainty by Farmers in Illinois," *This Journal*, Vol. XXXII, February 1951, pp. 20-39.

[2] Cf. K. E. Boulding, "The Theory of the Firm in the Last Ten Years," *The American Economic Review*, Vol. XXXII, No. 4, December 1942.

[3] Examples of non-static theories of production may be found in Gerhard Tintner, "The Theory of Production Under Non-Static Conditions," *Journal of Political Economy*, Vol. L, October 1942, pp. 645-67; A. G. Hart, "Anticipations, Uncertainty and Dynamic Planning," *Studies in Business Administration*, Vol. XI, University of Chicago Press, 1940; K. E. Boulding, *A Reconstruction of Economics*, New York, 1950; and G. L. S. Shackle, *Expectation in Economics*, London, 1949.

Techniques used were similar to those employed in other recent studies, but some new areas of the general problem, heretofore untouched by empirical research, were cautiously probed. Interrelationships between price expectations and production plans were emphasized.

The major objectives of this study were to determine the extent to which dairy farmers in one sample area, the Evansville, Ind., milkshed, anticipate the future correctly (if at all) and the extent to which such anticipations affect present production and marketing plans. These objectives were sought by (1) determining the nature of producers' expectations, (2) determining the foundations of expectations and decisions or delineating the factors considered in formulating milk production plans, and (3) relating plans and expectations to actual performance in subsequent periods.

Research Procedure and Data Collected

The procedures followed in this study were designed to test a number of specific hypotheses drawn from economic theory and other sources. However, before examining these procedures it is necessary to define several technical terms which will be employed.

UNCERTAINTY implies doubt, indeterminateness, and lack of certain knowledge. Any event expected with a probability of less than one is uncertain. Uncertainty includes all situations in which decisions are made without perfect knowledge of significant future events.[4]

ECONOMIC HORIZON is the end of that future period of time to which fairly well defined price and production expectations and marketing plans apply.[5]

VIEWPOINT is the point of time at which decisions and expectations are being formed in the mind of an entrepreneur.[6]

IMAGE-DATE is a point of time in the future with which the expectation is concerned. The image-date is a variable point of time which may vary independently in point of time from the viewpoint.

EXPECTATION is the mental association of one or more hypotheses concerning the outcome of an event at a specified image-date with some degree of belief concerning the validity of each hypothesis.

ELASTICITY OF EXPECTATIONS is the ratio of percentage changes in expected prices to percentage changes in actual current prices.

---

[4] For other definitions of uncertainty see: F. H. Knight, *Risk, Uncertainty and Profit*, New York, 1921, pp. 225ff; H. Makower and J. Marshak, "Assets, Prices, and Monetary Theory," *Economica*, Vol. V, pp. 261-88 and D. G. Johnson, *Forward Prices for Agriculture*, University of Chicago Press, 1947, p. 38.

[5] Cf. J. Tinbergen, "The Notions of Horizon and Expectancy in Dynamic Economics," *Econometrica*, Vol. 1, July 1933, p. 247.

[6] Definitions of "viewpoint," "image-date," and "expectation" used here were drawn from those adopted by Shackle. Cf. G. L. S. Shackle, *op. cit.*

A stratified random sample of 80 dairymen was drawn from a complete list of producers shipping to Evansville milk distributors. Stratifications were made by grade—Grade A and ungraded—and quantities of milk delivered during the year ending July 31, 1950. Grade A producers were divided into four size groups which roughly divided farms shipping milk to Evansville into those having sideline dairy enterprises, small and large general farms, and specialized dairy farms. No size stratification of ungraded producers was made because so few shipped more than 100 pounds of milk daily in 1950. A random sample of 16 (plus 4 alternates) was drawn from each of the five sub-groups.

Surveys of the 80 milk producers were conducted during the last week of January and the first week of February, 1951, and during the second and third weeks of June, 1951. These periods of survey provided two viewpoints which will be referred to as the *February viewpoint* and the *June viewpoint*. In the first survey, *i.e.*, at the February viewpoint, questions referred to various past dates and to four future dates: February 1951, June 1951, February 1952, and February 1953.[7] Thus, four image-dates were provided for each producer. Questions of the June survey referred to the previous viewpoint and to the last three of the above four image-dates.

At both viewpoints expectations of the blend price of milk for image-dates considered were determined as follows: each producer was asked to state three separate expected prices for milk deliveries of the month in question, *i.e.*, (1) the "most probable price" or the price the farmer considered most likely to prevail, (2) the "highest probable price" or the highest price the producer thought there was any chance at all of receiving, and (3) the "lowest probable price." Replies to these questions provided three points on the producers' subjective probability distribution of expected prices for each image-date.[8]

Farmers were asked to report and estimate the number of milk cows and heifers and other livestock on the farm during certain past periods, at present, and at certain image-dates. Interviewers obtained similar estimates of milk deliveries. Other types of anticipations were obtained including expected changes in total farm acreage, relative prices of milk and other farm commodities, and averages of prices received and paid

[7] To ask for an expectation of the February 1951 price at the beginning of that month was reasonable since the price paid for milk delivered during the month would not be known until about March 15.

[8] These points admittedly are hardly sufficient to establish the shape of a probability distribution curve. However, most other techniques would have involved asking farmers to assign probability values to a whole range of possible prices. This was rejected on the grounds that it was highly complicated and that farmers do not ordinarily think in terms of specific probabilities but only in terms of rather vague concepts of probable outcomes.

by farmers in the area. In addition, inquiries were made to obtain reasons for expected changes in price, herd size, volume of deliveries and other enterprises. At the June 1951 viewpoint, most of the questions of the February survey were repeated, and producers were asked to state reasons for changes in plans and anticipations which had occurred since February.

The data were cross tabulated, analyzed and tested by grade and size of farm and by age, experience, tenure status, and price optimism of producers. Differences by viewpoint and image-date were calculated. Regression techniques and tabular methods were employed to hold constant, simultaneously, several of these variable quantities. In this paper, space does not permit detailed consideration of all these elements and associated findings.

Degree of Response to Survey Questions

The 80 sample farmers appeared to respond to nearly all questions as well as they were able. Interviewers were instructed not to prompt or "pump" any of the more reluctant or less able respondents. For these reasons it is believed that the data of Table 1 reflect accurately the extent of unwillingness or inability among respondents to predict future prices, cow numbers and milk deliveries.

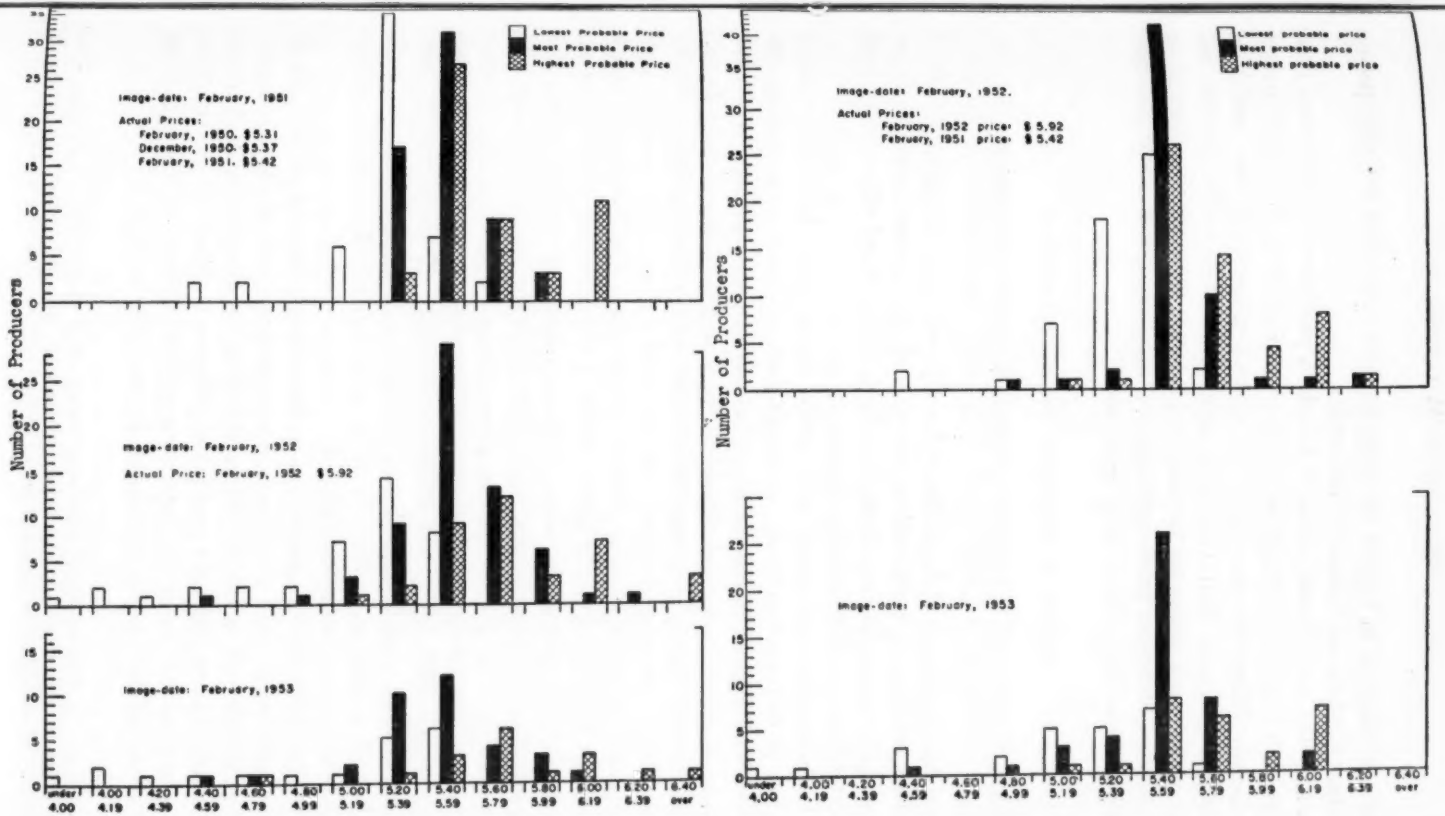
TABLE 1. NUMBER OF PRODUCERS WHO WERE WILLING TO INDICATE ANTICIPATIONS OF PRICES, COW NUMBERS, AND VOLUME OF MILK DELIVERIES

Viewpoints and image-dates	Number of producers willing to report anticipations			
	Most probable prices	Highest probable prices[a]	Cow numbers	Milk deliveries
February 1951, viewpoint				
February 1951	71	62	80	79
June 1951	68	61	78	75
February 1952	66	51	77	70
February 1953	39	23	74	55
June 1951, viewpoint				
June 1951	72	69	79	79
February 1952	71	66	77	69
February 1953	51	30	73	43

[a] Numbers of producers reporting lowest probable prices at each image-date were identical with those reporting highest probable prices.

The data of Table 1 indicate that distant image-dates were associated with a greater degree of non-response than image-dates of the near future. Differences in this respect were highly significant for expected prices and expected milk deliveries.[9] In addition, non-response was significantly

[9] Significant differences were measured by Chi-square or analysis of variance tests at the .05 level.



Viewpoint: February 1951 Viewpoint: June 1951

Expected Prices (Dollars) Per 100 Pounds of Milk, 4% Butterfat equivalent

FIG. 1. FREQUENCY DISTRIBUTIONS OF EXPECTED PRICES, 64 GRADE A MILK PRODUCERS. EVANSVILLE, INDIANA, MILKSHED.

more pronounced in regard to price expectations than for anticipations of future herd size or volume of deliveries.

Among the size stratifications of Grade A producers and between viewpoints, differences in willingness to report expectations were small and not significant. However, ungraded producers responded less readily in quantitative terms than Grade A producers. Also, older farmers and those with many years of farming experience were more reluctant, on the average, to report price expectations than younger or less experienced farmers. These differences were significant.

Nature of Producers' Price Expectations

Characteristics of Evansville producers' price expectations are summarized in Figure 1 which shows frequency distributions of prices expected by producers at both the February and June viewpoints. Table 2 provides additional information concerning the general nature of producers' price expectations. From the chart, Table 2 and other data several important observations can be drawn.

(1) Uncertainty associated with price expectations held by producers appears to increase markedly as image-dates become more remote from a given viewpoint.[10] Conversely, price uncertainty appears to decrease with an advance of the viewpoint toward a given image-date. In such advance of the viewpoint, price uncertainty of the distant future was less affected than price uncertainty of the near future. The greater ranges in expected prices for more distant image-dates are clearly evident in Figure 1. Differences indicated in Table 2 between average highest and lowest probable prices increase markedly and consistently as the time span into the future increases. Such differences for particular image-dates were considerably smaller at the June viewpoint than at the February viewpoint. The standard deviations of expected most probable prices for February 1951, 1952 and 1953, are 15 cents, 27 cents and 32 cents, respectively. In addition, as shown in Table 1, decreases occurred in the number of producers willing to state price expectations as increasingly distant image dates were considered.

(2) The tendency for producers to project recent past prices into the future with only slight modification was pronounced. Modal averages of most probable prices do not differ significantly among image-dates and are closely related to recent past prices (Figure 1). Similarly, no significant differences occur among average most probable prices of Table 2. These tendencies will be considered more fully in a later section.

---

[10] Two principal measures of price uncertainty were employed: (1) average differences between highest and lowest price expectations, and (2) standard deviations and coefficients of variability of expected prices.

TABLE 2. AVERAGE PRICES EXPECTED BY 64 GRADE A PRODUCERS AND DIFFERENCES BETWEEN AVERAGE EXPECTED HIGHEST AND LOWEST PROBABLE PRICES

Viewpoint and image-date	Average expected prices[a]			Differences between highest and lowest probable prices
	Most probable prices	Highest probable prices	Lowest probable prices	
	Dollars per 100 pounds of milk 4% butterfat equiv.			
February 1951, viewpoint				
February 1951	5.48	5.66	5.30	.30
February 1952	5.50	5.77	5.21	.56
February 1953	5.51	5.80	5.17	.63
June 1951, viewpoint				
February 1952	5.51	5.65	5.33	.32
February 1953	5.48	5.74	5.21	.53

[a] Calculated using total number of producers in each substrata of the population as weights.

(3) All distributions of price expectations approximate normal frequency distributions except that highest and lowest probable price distributions are slightly skewed upward and downward, respectively. Also, as might be expected, the distributions overlap.

(4) Rounded or convenient prices, *e.g.*, $5.50, were reported by producers more frequently than other prices.

Operators of large and small Grade A dairy farms seemed about equally uncertain and equally inaccurate in forecasting future milk prices. The same conclusion applies to producers classified according to tenure status, but price anticipations of producers 35 years of age and older were associated with a significantly greater degree of accuracy and a significantly smaller degree of uncertainty than price expectations of younger producers. However, as pointed out above, older producers responded to interrogation less readily than younger operators. One plausible explanation of this apparent inconsistency is that older men may have gained, through experience, a keener appreciation of the variability associated with prices and so hesitated to predict. Still, those who did respond may have had, again through experience, better bases for making price estimates.

The above findings, including those derived from Table 1, suggest conclusions that (1) while farmers are uncertain of the future, uncertainty definitely increases, or confidence in expected values decreases, as more distant image-dates are considered, (2) the time span of a farmer's economic horizon is limited and varies with the economic factor under consideration; a farmer's forward vista is greater or more clearly delineated with respect to future yields, facilities and production than with respect to future prices, (3) the size of the dairy enterprise, as well as the tenure status of the producer, is not related to the degree of price uncertainty felt by the operator and (4) age and experience of the producer and the level

and character of recent past prices are among the more important variables bearing upon producer price expectations.

Foundations of Producers' Price Expectations

One of the objectives of this study was to determine how farmers formulate price expectations. Within the last decade several attempts have been made to determine expectation models applicable to agriculture.[11] All these investigations indicate that recent past prices play a dominant role among determinants of price expectations. No attempt was made in this study to test alternative expectation models. Instead, emphasis was placed upon exploration of considerations and facts used by farmers as bases for price estimates.

Recent Past Prices

At the February viewpoint about 20 percent of the farmers stating price expectations apparently projected the most recent past price received by them (the price for December 1950 deliveries) to all future image-dates without change. In June, about the same proportion of producers projected the realized February 1951 price in making price estimates for February 1952. In both the February and June surveys, between 61 and 71 percent of the producers projected their price expectations for the nearest February image-date to future Februarys with a difference of 10 cents or less (Table 3). At the June viewpoint farmers who revised their February price expectations for June, *i.e.*, for milk delivered in June, upward or downward did so primarily because April and May 1951 prices had been higher or lower than expected. In addition, many farmers clearly indicated to interviewers that they were basing

TABLE 3. PERCENT OF 64 GRADE A MILK PRODUCERS INDICATING SMALL OR ZERO DIFFERENCES BETWEEN MOST PROBABLE PRICES ASSOCIATED WITH VARIOUS IMAGE-DATES

Viewpoints and image-dates for which most probable prices are compared	Most probable prices of various image-dates	
	No difference	Differences of 10 cents or less
	Percent of all Grade A producers	
Viewpoint: February 1951		
Image-dates compared		
Feb. 1951–Feb. 1952	51	71
Feb. 1952–Feb. 1953	61	77
Feb. 1951–Feb. 1953	44	67
Viewpoint: June 1951		
Image-dates compared		
Feb. 1952–Feb. 1953	45	61

[11] See footnote 1.

their expectations to a considerable degree on prices received during the then recent past. They did this by "thinking aloud," by referring to their farm records, or, infrequently, by asking interviewers to quote blend prices paid in Evansville in certain past months.

Other Commodity Prices

Expected trends of all farm prices (received and paid) seem to be important factors operating to modify influences of recent past prices of milk upon expectations of future milk prices. Among Evansville milk producers a high correlation between expected prices of milk and expected prices of other farm products appears to exist. In addition, both these series are closely related to changes expected in the level of all prices Evansville farmers pay for items used in production and in the household.

TABLE 4. NUMBER OF MILK PRODUCERS AND ASSOCIATED REASONS GIVEN IN FEBRUARY 1951 FOR EXPECTING MOST PROBABLE PRICES OF SELECTED FUTURE MONTHS TO EXCEED PRICES PAID IN CORRESPONDING MONTH, 1950[a]

Reasons indicated for expecting most probable prices to exceed actual prices corresponding month, 1950	Image-dates for February 1951 expectations				
	February 1951	June 1951	February 1952	February 1953	Total
	Number of producers				
Milk demand to increase	13	20	16	10	59
Milk supply to decrease	6	8	8	5	27
All other prices up	29	30	27	14	100
Cost of production up	26	25	19	8	78
Recent retail milk price rise	22	9	4	0	35
Other reasons	11	21	14	11	57

[a] Some producers gave more than one reason.

It appears that some farmers' expectations of milk prices were affected by their expectations of other prices, but the importance of this relationship could not be established with certainty. As the data of Table 4 shows, the largest number of reasons given in the first survey for expecting future February milk prices to be higher than they had been in February 1950 were that (1) farm prices generally and (2) prices of productive factors were rising or were expected to rise. Evansville producers appear to believe that if "production costs" increase, these increases will "somehow" be reflected in future prices. In June, approximately one-half the farmers who revised their milk price expectations upward did so because increases in all farm prices during the interval between the two surveys were greater than expected (Table 5). Also, about 30 percent of the reasons given by producers at the June viewpoint for revising their milk price expectations downward were that the general

trends of all farm prices had increased less between February and June 1951, than had been expected (Table 5).

Among the conclusions which may be drawn from the above findings are the following. (1) Most Evansville dairy farmers apparently use recent past prices as their principal bases for forecasting future prices which means that elasticity of price expectations among these farmers may be nearly unity. Some farmers simply project past prices into the future without modification. (2) The majority of farmers in making price expectations while starting with recent past prices adjust these in accordance with their price expectations of other farm commodities and products

TABLE 5. NUMBER OF PRODUCERS AND ASSOCIATED REASONS GIVEN AT THE JUNE 1951, VIEWPOINT FOR REVISING PREVIOUS EXPECTATIONS OF PRICES FOR FEBRUARY 1952 AND FEBRUARY 1953

Type of revision and reasons for such revision	Image-dates	
	Feb. 1952	Feb. 1953
	Number of producers	
Upward revisions:		
February 1951, price higher than expected	13	10
Greater than expected increase in all farm prices	6	7
Other	9	6
Total	28	23
Downward revisions:		
February 1951, price lower than expected	13	4
Less than expected increase in all farm prices	8	5
Other	4	7
Total	25	16

farmers buy, of supply and demand conditions in the Evansville milk market, and of general economic conditions. (3) Most farmers appeared to feel that all farm commodity prices usually move up and down together which, of course, implies that milk prices relative to prices of other farm commodities remain quite stable over time.

Nature of Producers' Production Plans

At both viewpoints, February and June 1951, most Evansville producers were planning increases in sizes of dairy herds within the forthcoming one or two years. These plans differed significantly from actual accomplishments during the preceding one or two years, among producer groups, and among image-dates (Table 6).

Although only 46 percent of the sample producers had increased dairy herd size in a two year period from 1949 to 1951, 70 percent were planning in February 1951, to enlarge their herds by February 1953. As shown in Table 6 average expected increases greatly exceeded increases

over comparable periods in the past. Also, planned increases for the period February 1951, to June 1951, fell far short of being realized.

Large-volume Grade A producers and ungraded producers expected significantly smaller increases in cow numbers for most image-dates than small-volume Grade A producers. However, in percentage terms the increases planned by small-volume producers exceeded those of other groups.

TABLE 6. COMPARISONS OF AVERAGE ACTUAL AND EXPECTED CHANGES IN COW NUMBERS PER FARM BY LARGE AND SMALL GRADE A PRODUCER GROUPS AND UNGRADED PRODUCERS

Viewpoints, image-dates and types of comparisons	Grade A producers and pounds delivered daily			Ungraded producers
	Under 200	200 and over	All Grade A[a]	
	Average actual and expected changes in cow numbers per farm			
February viewpoint:				
Expected and actual past changes				
One year differences				
Actual: Feb. 1950–Feb. 1951	0.0	+2.0	+0.8	−0.9
Expected: Feb. 1951–Feb. 1952	+2.5	+1.8	+2.1	+0.9
Two year differences				
Actual: Feb. 1949–Feb. 1951	+0.6	+2.7	+1.7	−1.3
Expected: Feb. 1951–Feb. 1953	+3.4	+2.8	+3.1	+1.2
Expected and realized changes				
Realized: Feb.–June 1951	0.0	−1.0	−0.2	+0.1
Expected: Feb.–June 1951	+0.8	+0.3	+0.5	+0.3
June viewpoint and expected changes				
Feb. 1952	+1.4	+0.9	+1.5	+0.9
Feb. 1953	+2.9	+2.1	+2.7	+1.3

[a] Calculated using total number of producers in each substrata of the population as weights.

No consistently significant differences by tenure status in plans regarding herd size were discovered, but differences among age and experience groups of producers were significant. Producers under 35 years of age planned in February 1951 to add an average of 5.1 cows to dairy herds by February 1953. But producers 50 years of age and older planned an average increase of only 1.6 cows for the same period.

Differences among image-dates in magnitude of expected changes in dairy herd size and in numbers of farmers planning dairy herd expansion or contraction were significant. In February 1951, only a third of the sample producers were planning to increase herd size by the following June. At the same time, 62 percent expected to increase herd size by February 1952 and 70 percent planned to have enlarged the herd by February 1953.

The apparent recognition of the time element in dairy herd expansion suggests a prevailing desire to enlarge dairy herds from home-grown

stock, the existence of capital limitations or expectations of gradual improvement in the relative profitability of dairying. All these factors may have been present. Although capital rationing may have been exerting an influence, evidence presented in the next section indicates that producers generally were not expecting relative increases in blend prices of fluid milk.

Farmers expectations of future milk production and deliveries, in general, were consistent with planned changes in cow numbers. Pronounced increases in volume of milk deliveries were anticipated. Also, these expected increases were significantly greater than those made in the then recent past. Some important differences between expectations of milk deliveries and dairy cow numbers were discovered. However, these differences appear to have resulted, in the main, from the greater difficulty of estimating future milk output.

The principal conclusions suggested by evidence presented in this section are that (1) farmers make fairly specific production plans for short future periods, (2) although milk producers formulate expectations of the extent to which these plans will be realized, they typically (a) overestimate their ability to expand herd size and volume of deliveries, (b) underestimate the possibility of misfortune, or (c) report plans they merely hope rather than actually expect to fulfill.

Bases of Producers' Production Plans

In this study it was assumed that some sort of relationship existed between Evansville milk producers' price expectations and their production plans even in the short-run. However, the nature and importance of that relationship was not known. For this reason several techniques were employed to determine the importance of price expectations in formation of production plans. Consistent findings were obtained by all methods of analysis. They indicate that although producers formulate and consider price expectations in making their production plans they accord them little weight.

(1) Evansville milkshed farmers were asked to state reasons for planned changes in cow numbers and milk deliveries. Of those producers who planned increases in cow numbers when interviewed in February 1951, only 15 percent mentioned expected prices or price ratios. Fifty-nine percent of these producers said that such increases were necessary to utilize feed, labor or facilities; 13 percent said that planned increases constituted replacements of cows lost recently through culling or misfortune and the other 13 percent were either unable or unwilling to express reasons.

(2) Correlations were made between price expectations and (a) planned changes in cow numbers, (b) expected changes in volume of deliveries. No significant or consistent results were obtained. This is true also of com-

parisons made between production plans and an index of price optimism.

(3) As a third technique farmers were asked if they varied rates of feeding according to relative prices of milk and feed. An overwhelming majority, 70 of 79 producers answering this question, replied in the negative. Upon further questioning three principal reasons developed for maintaining feeding rates without regard to prices. These were: (a) desire to maximize milk production irrespective of cost, (b) belief that certain (standard) feeding rates are optimum under all price conditions and (c) widespread sentiment concerning moral obligation to feed animals "properly." Eight producers said the milk-feed price ratio did not vary enough to warrant feeding adjustments. A number referred to time relationships in production. These references were made by saying that a reduction in feeding rates would result in lower production in the following lactation period, lower quality calves or both.

(4) A fourth approach involved questioning respondents concerning relationships among prices of milk and prices of other major products produced in the Evansville area. Most producers either expected no change in the price ratios considered or could not decide what they expected. Of the producers who indicated an expected relative rise or fall in the price of hogs, 70 percent said that such an expected relative price change would not affect their production of milk.

(5) In another series of questions farmers were asked at the June viewpoint to suppose that the actual price paid for milk in February 1952, 7 months later, was one dollar per hundredweight (a) higher (an increase of about 20 percent), (b) lower than they currently expected it to be. They were asked to suppose that all other things, in the interim, would remain unchanged. With respect to the higher-than-expected price only 17 of 79 farmers said this would cause any change in production plans.

In the case of lower-than-expected prices 32 of 79 producers reported that such a disappointment would cause them to sell cows immediately, cull closer or shift to other enterprises as rapidly as possible. Of 44 producers who reported no immediate change in plans, a number suggested they would be watching further developments. Their reaction, they said, would depend upon what happened to prices of other farm commodities. However, most reasons advanced for not adjusting herd size in response to a drastic change, up or down, in the price of milk were related to: (a) need for income or need for regular income, in the event of price decreases, and limitations of physical facilities, feed and labor, in the event of price increases; (b) inability to follow price changes or the costliness of doing so; and (c) a strong belief that farm product price ratios change little over time. These are logical reactions. The broader movements of farm product prices are, in fact, highly correlated, and pro-

ducers feel there is little reason to be concerned with prices since milk has and probably will continue to maintain its relative price position. They feel, too, that there is insufficient time and it is too costly and risky to adjust to price changes which are expected to be temporary. If price changes are foreseen and they are expected to be permanent, producers believe they should delay changes in plans and production operations until after the change has occurred and remained changed long enough to verify expectations. Also, farmers like the price stability, the income regularity and the certainty associated with milk production and place much emphasis upon the complementary nature of many enterprise combinations which include dairying.

Although these findings appear conclusive, analysis of other relevant considerations suggests that price is a more powerful decision factor in the market than implied by producers. One such consideration is the apparent tendency among Evansville milk producers to take the existing structure of prices for granted and to mention factors as reasons for changes or planned changes. In response to direct questioning, producers usually admitted they had considered expected prices in formulating production plans. In addition, the increase in milk production for fresh consumption, which occurred in the Evansville milkshed over the period 1934 to 1951, appears to be positively correlated with an increase in the blend price of milk relative to manufacturing milk prices.

Another consideration involves the indicated importance of unused productive resources on Evansville milkshed farms as a motivating force for dairy herd expansion. In this connection, two fundamental factors appear. The first is that many of the farmers who said they had unused capacity on their farms were relatively young men. The second factor is more basic and was peculiar to the Evansville milkshed at the time this study was made. In 1947, Grade A regulations were introduced in the Evansville milk market. The additional investment generally necessary to meet Grade A requirements caused many small-volume producers to leave the market and encouraged many who remained to increase their production. At the time surveys of this study were conducted many farmers had not yet completely adjusted their operations to the resulting changed production conditions on their farms. This may account for a considerable portion of the reasons for herd expansion relating to unused resources.

A final important consideration is the following: the effect upon production, if any, of a price change is all in one direction. When dealing in aggregates, effects of other important factors such as labor or feed supplies frequently offset one another. At a particular time, one or more of these factors may influence production upward on one farm and downward on another. Thus, price may be relatively unimportant on individual

farms, but, even in the short-run, still may be the most influential decision factor in the market.

Concluding Remarks

Any importance which might be attached to this study lies in the few basic theoretical concepts which were investigated and tested, the methods which were employed in collecting information, and the hypotheses suggested for future empirical investigation. It adds bits of evidence concerning the validity of certain hypotheses in an important area of economic investigation where such evidence is particularly scarce. Although incomplete in many respects, the experiment (1) described anticipations and plans at two points of time as they applied to various future dates, (2) traced some of the divergences between plans and realizations, and (3) attempted to determine the manner in which plans and anticipations were realized or revised and to note the reasons for revisions. Much additional exploration and analysis is needed in these frontier areas.

Dynamic models are highly complex structures. Studies to date indicate that, in addition to economic forces, expectations and plans are affected by a multitude of social, political and psychological factors many of which economists are not, at present, well-equipped to measure. This suggests that future research, to determine expectation models and decision functions, might well be more fruitful if economists and econometricians sought the assistance of other social scientists. But whether or not an interdisciplinary attack is made of these fundamental problems, it is certain that sharper measuring tools are needed. The method of survey is clearly inadequate. Also, there is definite need for both refinement and better organization of basic theoretical models.

In any study such as this, non-homogeneity of the sample is a problem. Milk producers of the Evansville area, being relatively isolated from other large market centers and producing about the same commodities under roughly similar conditions, are, perhaps, more homogeneous than any other group of producers in Indiana. Still, excessive cost in relation to value of results obtained and great complexity would have resulted from stratifying to the point where units of the substrata were relatively homogeneous. And this would not have solved, completely, the problem of interrelationships among such variables as age and experience or capital investment and education received. However, among milk producers a number of factors now appear to be more important in determining expectations and decisions than grade and size of milk producer—the factors by which the sample in this study was stratified.

Data and results of the study would have been more meaningful if stratifications or tabulations had been made according to the degree to

which producers had obtained a sort of "equilibrium" of capital investment and production operations to long period plans. Many relatively young producers and others planned to increase farm acreage and the size of all farm enterprises including dairy. Some older producers and many of the producers operating relatively large farms were primarily concerned with inter-enterprise adjustments. In addition, some producers had, while others had not, adjusted to changed marketing conditions which occurred during and after World War 11.

Some new points of attack and some new theoretical tools may be available and, if so, should be used. Shackle's "surprise function" and his "stimulation function" have engendered interest.[12] Some attempt should be made to derive these functions statistically for they may facilitate study of several hypotheses concerning the nature of economic expectations.

Boulding's asset preference structure permits study of response to various stimuli without reference to the expectations which may have prompted the response.[13] There appears to be some possibility of measuring preferred asset ratios, of observing existing asset combinations, and of inquiring into reasons for differences between them. Further, the time patterns of change in existing and preferred asset ratios may be subject to measurement. If so, relationships among these changes and various social and economic forces could be investigated.[14]

---

[12] Cf. G. L. S. Shackle, *op. cit.*

[13] Cf. K. E. Boulding, *A Reconstruction of Economics*, New York, 1950.

[14] For additional suggestions and for a list of unresolved questions, some of which relate to theoretical as well as practical difficulties encountered in the course of this study, see Willard F. Williams, *op. cit.*, pp. 187-89.

THE PROCESS OF INTEGRATION AND AGRICULTURAL PROBLEMS*

STEPHEN L. MCDONALD
The University of Texas

AGRICULTURAL problems as arising from or related to the business cycle, and the production economics peculiar to the agricultural firm, would seem to have received near-exhaustive treatment in the literature. But there is another order of problem origins which, the present writer believes, has not had sufficient attention, namely: origins in the historical economic development of the country and the changing relationship of agriculture to the remainder of the economy. Such discussion as there has been at this level of generalization has lacked a rationale, a systematic mode of analysis. This paper is an attempt to suggest the barest outlines of a possible approach to this order of problems, and to suggest an additional criterion for policy proposals and action programs.

The Concept of Integration

The theoretical concept which enables a rationalization of functional and regional specialization is that of *integration,* a concept which has been implicit in economic thought since Physiocracy. "To integrate" means to form into a whole; to unify. The integrated economy is one in which each separate economic process is so functionally related to every other process that the totality of separate operations forms a single unit of production with characteristics all its own. The implication of integration is a certain efficiency of over-all operation impossible to realize under conditions of independent operation of the separate processes. It is, therefore, of the very essence of economic thought.

The prime example, of course, is the integration of industrial and business operations at the firm level, universally discussed in the textbooks with the modifiers, "vertical" and "horizontal." This discussion invariably involves the observation that such integration has certain industrial and/or business advantages which manifest themselves in the earnings of the firm in question and, perhaps, in the economic welfare of the community at large. These advantages derive from specialization without ad-

* This paper was originally read under the title, "The Theoretical and Practical Problem of Integrating Agricultural and Non-agricultural Economic Activities," before a joint session of the Agricultural Economics and Economics sections of the Southwestern Social Science Association, meeting in its annual convention at Dallas, Texas, April 10–12, 1952. The general topic of this joint session was "Regionalism in an Integrated Economy." The original text has been shortened and slightly revised in order to adapt it to the present medium.

ministrative separation. The economies of specialization are realized, yet each specialized process is caused to conform to a larger plan of operation so that the various processes are never functionally distinct but blend smoothly into a single process. The integrating agent in this case is purely the administrative control vested by law in ownership and its assigns. Exchange relations between sub-firms of the integrated concern are typically for accounting purposes only and do not govern administrative decisions.

It should be clear that the question of integration within the business firm, the industry, or the economy, arises only if and when some degree of specialization occurs. The economic *area* of the integration problem expands throughout the course of history from the family to the tribe, to the town and manor, etc., conceivably to the entire world, chiefly in accordance with the technology of communication. The *depth* and *intricacy* of the integration problem is a function of the variety and number of economic processes created by advancing technology and coming within the scope of existing control-power institutions—family, firm, state—at each stage of cultural development.

Under any system of control-power institutions, whether control is exercised through direct discretionary authority (e.g., in the firm or the socialized economy) or through checkmating relationships of localized authority (e.g., the ideal *laissez faire* economy), integration means or implies certain uniform manifestations:

1. Many diverse, specialized, and interdependent economic processes or operations, none of which is complete or self-sufficient.
2. A system of relationships between the various processes which serves to register this interdependence upon the conduct of each process so that all are caused, in some manner, to fall under the over-all plan.
3. A concatenation of processes in unified pursuance of the aims and purposes of the larger scheme of things.
4. A mutual replenishment of spent resources to the end that the continuity of each and all processes shall not be jeopardized.

In a purely technical sense, economic integration is a matter of what Veblen called "the running maintenance of the interstitial adjustments between the several . . . branches of industry."[1] The output of each integral process is never "finished" in the sense that at some point its employment is consummatory and quite divorced from the continuity of productive activity. The output of each operation moves to another where it is modified, converted to a new form (including labor power), and dispatched for further employment and re-embodiment in a continuous,

[1] Thorstein Veblen, *The Theory of Business Enterprise*, Charles Scribners Sons, New York, 1932, p. 8.

circulatory process *ad infinitum*. The spent resources of each stage are continuously replenished by the products of others in an intricate pattern of exchanges. Thus viewed, exchange operations become functionally merged into productive activity, no more distinct from the latter than the motion of an assembly line is operationally distinct from the attachment of constituent parts to an emerging automobile. There exists no conceivable beginning to the production of any good, or of all goods; and there is, therefore, no time dimension attributable to the production of any good or type of good.

Under capitalistic institutions, the technical apparatus and methods of producing goods are caused, with legal sanction, to be subservient to and controlled by the exigencies of business, or "making money." That is to say, the great preponderance of decisions affecting the ordinary conduct of productive processes are made by businessmen for business purposes. All technical matters must be translated for the businessman—the decision-maker—into terms of pecuniary outlay and income; and whenever the workmanlike conflicts with the businesslike, the latter invariably prevails. Thus, the key to integration under business methods is not simply the technical linkage between interdependent processes, but the continuous pecuniary satisfaction of parties to the necessary exchange transactions. Integration under capitalism runs in terms of the pattern of relative commodity prices, relative incomes of owners of productive resources, and relative expenditures of income recipients essential to mutual pecuniary satisfaction; in terms of the continuous flow of circulatory payments, from business cost outlays to consumption expenditures.

The Process of Integration

More important for our purposes is the notion of integration as a *process* of continuous adaptation of the economy and its myriad segments to altered historical circumstances, of continuous maintenance of a reasonable working efficiency of the economy as a whole and of its sub-processes.

In general, the process of integration resolves itself into continuous reallocations of productive resources among segments of the economy and productive processes, which are in more or less constant flux in response to historical change. These changes are diverse in type and form. In terms of economic activity they all have the effect of saying more of this product and less of that one, more of this factor and less of that one, more here and less there, more now and less then. A new product (or process, etc.), for instance, often means the demise of an established one; under conditions of full employment it has to mean a general reshuffling of productive resources. It may mean that new skills have to be developed and old ones abandoned. It may mean new centers of economic activity, a rechanneling of the flows of goods through new geographical areas. The

possible re-allocative adjustments are virtually unlimited. The process of integration is the orderly adoption of these changes within the framework of a going economy without impairment of the affected industry, or of any other industry, or of the total economy—without entailing panic and poverty, and without evoking public action which might then inhibit adaptation to further change.

In the case of agriculture, considered for our purposes as a distinguishable segment of the American economy, a special problem is involved in the process of integration. We refer to the fact that in this country agriculture has never really "belonged" without reservation to the remainder of the economy, and vice versa. This certain aloofness of agriculture from the American economy is due partly to the peculiar attributes of agriculture everywhere, and partly to the singular historical processes of the country's settlement and development.

With reference to the peculiar attributes of agriculture, wherever found, one calls to mind the reasoning underlying a well-known scheme of economic relationships, Professor Erich W. Zimmermann's "resource hierarchy."[2] Professor Zimmermann places "the power-metal-science system (including commerce, finance, transportation, and communication systems)," at the center, and by a series of concentric circles depicts the places of progressively "weaker" systems, ending at the periphery with "the climate-soil-topography system," the production of agricultural annuals. Industries such as manufacturing and transportation have been able to enjoy the inherent advantages of inanimate power and mechanized processes, the advantages of greater productivity and superior control over natural processes, quantity and quality of output, ease of competitive entry, etc. But agriculture was late to benefit from the mechanical revolution and remains to an extent dependent upon animate and biotic power, inhibited by the time-consuming processes of reproduction and growth, and buffeted by uncontrollable natural phenomena. The fundamental bases of agriculture, so profusely distributed over the world, and so patently resistant to human control, render their users strategically inferior in economic relations with the employers of the resources of mechanized industry. In short, there is a fundamental qualitative difference between agricultural and nonagricultural economic activities. The long-standing and persistent process of breaking down these functional differences may be designated as *Process of Integration Number One.*

Some factors in our politico-economic development give rise to *Process of Integration Number Two.* The first three centuries of our history are characterized by the sweep of the land-hungry frontier farmer across this continent, a movement which demanded, and begot, a fairly distinctive

[2] Erich W. Zimmermann, *World Resources and Industries,* Harper and Brothers, New York, 1951, p. 141.

frontier-agrarian philosophy of great political and economic significance. In the nineteenth century there emerges another movement, led by the industrialists and financiers, asserting and promoting another philosophy stemming jointly from the teachings of the English classicists and the lush opportunities of a new land. As this latter movement gained ascendancy and America became an industrial nation, it swept along the agricultural sector of the economy, contributing power, machines, and materials in exchange for foods and fibers, inexorably drawing agriculture into the complex of the industrialized, specialized, exchange economy.

Participation in the exchange economy dominated by business methods fosters certain habits of thought, indeed demands them as prerequisite to satisfactory business survival. By and large, these habits of thought involve the acceptance of mutual dependence of economic processes, the realization of this relationship in the market place, and the interpretation of "the means of production" as exchange values, as distinguished from use values. It is under the impact of this way of thinking that property, or evidence of equity, increasingly takes the form of negotiable instruments, access to markets gives significance to property, and control of money overshadows simple disposal over things.[3]

But the typical habits of thought of the American farmer have been different from, if not contrary to, those of businessmen. The frontier-agrarian tradition of self-sufficiency and landed independence has fostered a way of thinking in terms of use values and personal exchange relationships—a way of thinking which cannot fully appreciate the principles of "sound banking" and the role of futures markets in the production of goods and services. With respect to these two features of the economic system, the views and suspicions of the generality of agriculturists are too familiar to require citation of examples. The important thing is that the farmer's appraisal of economic activity is at present in process of modification, and that this development is a part of the general process of integrating agriculture with the remainder of the business-dominated economy.

If one doubts the dynamic quality of the process, let him compare the motif and tenor of today's agricultural journal with that of *The Prairie Farmer* and *The American Agriculturist* of seventy-five years ago. Better still, let him compare the *Proceedings of the National Grange*, today and yesterday. Just compare the Grangers' early faith in by-passing "unproductive middlemen" with the faith of their grandsons first in "orderly marketing" and then in restriction of output, and you have the nature of the process. As American farmers have become more specialized, more

---

[3] Cf. John R. Commons, *Legal Foundations of Capitalism*, Macmillan Company, New York, 1924, especially pp. 12–13.

completely reliant upon the market, their thinking has run increasingly in terms of marketability.

This process of adapting habits of thought to the requirements of a changing economic environment in agriculture is far from completed. The typical attitudes are too deeply imbedded in rural culture, too well catered to in the political realm, too highly idealized in the national myths to pass in a generation or two. Until the traditional agrarian habits of thought yield to the businesslike, American agriculture shall remain, to an extent, not wholly integrated with the remainder of the economy, and the economic efficiency of the whole shall suffer because of it. It is not that one pattern of thought is superior to the other in some absolute sense, but rather that one is realistic with respect to its environment while the other is not.

Let us now, for purposes of emphasis, summarize the immediately preceding remarks. Considering agriculture as a distinguishable segment of the national economy, we may observe two historical aspects of its process of integration with the remainder of the economy:

1. "Technical" integration: the process whereby largely self-sufficient processes, spatially and conceptually on the periphery of economic centers of activity, are being brought into the general scheme of the exchange economy and thereby are becoming functionally a portion of the total economy.
2. "Institutional" integration: the process whereby the habits of thought of agricultural producers are becoming adapted to the exigencies of the exchange economy—the process whereby the "sons of toil producing the basic necessities of life" become businessmen producing pecuniary claims against the various products of the total economy.

If and when these two developments shall be completed, the process of integration with respect to agriculture will become identical with the process in any other industry. But, insofar as the above two phases are still incomplete, agriculture in the United States presents a singularly dynamic situation (historically speaking) in which distinct maladjustments, as persistent features, may be detected.

Integrative Adjustments and Current Problems

Earlier it was said, that the process of integration resolves itself into continuous reallocation of productive resources among segments of the economy and different productive processes. In the case of American agriculture, there are three major lines of reallocative movements currently demanded by the historical development of the economy as a whole. They are: (1) a constant reduction in the proportion of labor resources engaged in agricultural enterprises; (2) a constant growth in the capital investment per agricultural unit; and (3) a constant shift in product emphasis from the staple foods and fibers to livestock products, fruits, and

vegetables. The efficiency with which these reallocative adjustments are jointly and severally made determines in significant degree the productive capacity of the total economy and especially the income-product of the agricultural sector and its several regional subdivisions.

The constant relative reduction of labor resources in agriculture is required by a set of historical developments, involving on one hand the growth of productive powers in agriculture and on the other a smaller growth in demand for products of agriculture. In the former category is the progress of agricultural technology, which in the last two decades has become phenomenal. Opposed to the forces of rapidly increasing productivity is an only moderate growth in the demand for agricultural products. A declining rate of population growth prior to World War II, the low income elasticity of at-the-farm demand for foods, the competition of artificial fibers, and the decline of farm product export markets account for this fact. Between these opposing pressures is the farm labor force, continually replenished from within by an annual excess of births over deaths in the farm population of about 400,000. The inevitable result is an unending farm-to-city migration and a diminishing proportion of our labor resources in agricultural pursuits—in recent years, a declining absolute number. This out-migration from agriculture is a reallocative movement induced by the historical development of this nation and required for continuous functional integration of agricultural and nonagricultural sectors of the economy. Failure of such migration to keep pace with the magnitude of its causal forces results, as it did in the 'thirties, in the relative impoverishment of the farming industry and the waste of large portions of the economy's labor resources.

The second integrative adjustment required of American agriculture is the constant growth in the capital investment per farm. This requirement is associated with the reduced employment of labor just discussed, the substitution of inanimate for animate power, the enlargement of farm units, and the growing emphasis upon livestock enterprises.

The third integrative adjustment identified earlier is a shift in the proportions in which the several types of American agricultural commodities are produced. The habits of consumption of the American public, the competition of synthetic and quasi-synthetic substitutes, and the decline of certain foreign markets combine to weaken the relative positions of cotton, wheat, pork, potatoes, wool, and similar old-line staple commodities and to strengthen the relative positions of livestock products—with possible exceptions of pork, lard, and butter—and fresh fruits and vegetables. As for the domestic consumer, his increasing real income, greater knowledge of and concern with proper nutrition, more sedentary occupations, and more comfortable clothing and housing account for his changing pattern of purchases. In the field of fiber substitutes, rayon, nylon,

orlon, dacron, paper (with others promised), are affecting primarily the cotton industry, but also, to a growing extent, the producers of wool. In foreign trade, our traditional agricultural exports such as cotton, pork, lard, and wheat suffer from growing foreign production, competition of substitutes, and the comparative advantages of our manufactured goods in an age of "dollar shortages."

It should be clear that lapse in these integrative adjustments must create agricultural problems: underemployment arising out of disruption of the normal farm-to-city migration flow, underproductiveness arising out of too little capital backing for farm labor resources, price disparities and embarrassing surpluses arising from rigid production and land-use patterns, and income disparity resulting from all three of the above in concert. It is interesting to review American agricultural problems of the inter-war period in this light.

Indicated Outlines of Agricultural Policy

The question arises, what national and regional economic conditions will be most permissive of, and conducive to, the kind of integrative adjustments required of American agriculture? First of all, the experiences of the depression 'thirties and the war 'forties demonstrate most conclusively that the maintenance of reasonably full employment in the *nonagricultural* sectors of our economy is absolutely essential to the continuous migration from farm to city of the agricultural underemployed. Everyone who has studied the question at all has noted the remarkable correlation between out-migration and industrial employment opportunity, and the seeming impotence of relative wage inducement in periods of widespread industrial unemployment.[4] These decades have demonstrated the importance of the barriers of finances, education, health, housing, and race to city-ward migration. They have suggested the tremendous potential of industrialization of the South and similar problem areas for alleviating the overcrowded and underproductive conditions in the agricultural economy so apparent a dozen years ago.

Secondly, continuous integrative adjustment in American agriculture requires the further adaptation of credit facilities in such a manner as to register more equitably the credit needs of farmers in the capital markets. Specifically, the reduction of "capital rationing" promises to be most fruitful in facilitating the investments in larger farms, more and better livestock, mechanical equipment, buildings, fences, and the like, requisite to a more productive agriculture.[5] Aside from "facilities," we need *attitudes*

[4] See, for example, Theodore W. Schultz, *Agriculture in an Unstable Economy*, McGraw-Hill, New York, 1945, pp. 98–105.

[5] Cf. Theodore W. Schultz, *Production and Welfare of Agriculture*, Macmillan Company, New York, 1949, Ch. 12. It must be assumed that greater stability of agricultural income is prerequisite to any significant reduction in "capital rationing."

on the part of borrowers and lenders alike that take account of modern trends and problems in agriculture: an appreciation of the role of credit in the modern economy, a willingness to deviate from traditional terms, a rejection of the philosophy which gives preference to land ownership, even when at the expense of more productive machines, techniques, and enterprises. Especially the modern farmer must cease to view the use of credit as unavoidably going into debt,[6] and begin to view it as an instrument of resource allocation.

Finally, if the shifts in the relative production of farm commodities are to be made, the pattern of inducements set up by relative commodity and factor prices must be permitted to have their impact upon the agricultural economy. It is one thing to support the prices of old-line, storable staples as an anti-cyclical measure; it is quite another thing to do so as a permanent feature of national policy, in bad times and in good. The attempt to maintain the prices of particular farm products at some fraction of historical parity—old, new, or transitional—can have no other effect than the perpetuation of subsidized inefficiency in the national and regional economies. Farm production must respond to the evolving needs for its output, and farmers should be aided to this end, if necessary. They must not be aided in resisting the mandate of changing patterns of demand.

There are two lines of thought, now implicit in national policy, which run contrary to the foregoing argument. The first, as just suggested, is that which views the farmer as having a legitimate "right" to some historical commodity price relationship and, incidentally, to some historical pattern of commodity production and land utilization. It seems superfluous to observe that not only changes in relative demand, but also changes in relative costs, are inherent in the progressive economy; that, therefore, there is every reason why relative prices *should* change over time, so long as we pretend to rely upon the relative price system to guide private production decisions.

The second contrary line of thought may be called "sentimental agrarianism." It has not the same explicit embodiment in policy as price supports, but it abounds in governmental and academic thinking. This way of thought views agriculture as *the* basic industry and the producer of *true* men, hard-working and honest, healthy and wise, independent and devout. It therefore regards with some alarm the industrialization, specialization, and commercialization of modern society, and the resultant declining and changing role of agriculturists. Its exponents' proposals range from returning to the self-sufficiency of yesteryears to the mere exalting of farm ownership in family units above all other considerations.

---

[6] Cf. William G. Murray, *Agricultural Finance*, The Iowa State College Press, Ames, 1947, pp. 3–4. The above discussion of farmers' habits of thought is pertinent at this point.

They find some justification in price supports, because the farmer after all is the "back-bone of civilization" and entitled to *some* consideration.[7]

It is, of course, natural to find such attitudes in a society the history of which has rested so largely upon agricultural enterprise and agrarian economic and political philosophies. Are we not nearly all the sons and grandsons of farmers? Have we not the rosiest memories of a departed way of life? But when sentimental agrarianism exceeds the bounds of national nostalgia and fixes itself in the policies of the country, it cannot be viewed with complacency. Unless we are prepared to prohibit all further technological change, in agriculture or outside it, we must accept the changing role of agriculture and its changing requirements for functional integration with the remainder of the economy. The institutional integration of American agriculture involves the acceptance by farmers and others alike of the mutual dependence of modern economic activities. To deny it and embody the denial in policy is to make of agriculture, as Murray Benedict once put it, ". . . an institutional home for the underprivileged . . . , a sociological Fort Knox in which to bury and immobilize human resources we are not wise enough to use in more significant and productive ways."[8]

Conclusion

It is here maintained that the future of American agriculture must be viewed in relation to the larger whole of which it is a part; that this future is to be realized in the functional integration of agriculture with the remainder of the economy, as a continuous process over time in a dynamic society. It therefore follows that agricultural policy should look to facilitating integrative adjustments rather than, say, to ameliorating poverty as such or achieving some sort of tenable "balance" as between agricultural and other interests.

---

[7] An outstanding statement of this whole line of thought is to be found in O. E. Baker, Ralph Borsodi, and M. L. Wilson, *Agriculture in Modern Life*, Harper and Brothers, New York, 1939, especially in Part II.

[8] Murray Benedict, "Schisms in Agricultural Policy," *This Journal*, May, 1942, p. 495.

THE "LABOR VACUUM" AND COTTON MECHANIZATION

JAMES H. STREET
Rutgers University

TO WHAT extent has the process of mechanizing cotton farming in the South been accelerated by a reduction in the available labor force? The assertion has frequently been heard in recent years that cotton mechanization is no longer to be feared as a movement displacing farm workers, but that it is rather a response to a "labor vacuum" which began to make itself felt in World War II. If this is indeed true, and if the trend should continue, certain heretofore troublesome problems would be greatly alleviated. The long-needed reduction in southern farm population would seem to be taking care of itself by the most desirable avenue: voluntary departures by the people to take up more promising economic opportunities. And mechanization for greater farming efficiency could henceforth be expected to go on as rapidly as technological advances could be made.

Southern producers have often complained of labor shortages during and since the war, and available statistics on first inspection seem to bear them out. The war years witnessed the sharpest decline in farm population ever experienced in this country within a similar period, and the South was the region with the greatest losses. Three and one-third million people left farms in the sixteen southern states from 1940 to 1945—a decline of one fifth in the number of farm residents.[1] About half of this loss had been made up by 1949, yet the net decline since 1940 of 1,624,000 persons was still substantial, especially when one considers that the departures from the farms tended to be concentrated in the vigorous young adult age groups.

Can we say, then, that a new man-land ratio has been established in the South which is forcing mechanization as a replacement for departed hand labor? Or is the process of mechanization largely subject to inde-

[1] U. S. Department of Agriculture, *Agricultural Statistics, 1948,* p. 542; *ibid., 1950,* p. 580. In the discussion of recent population movements which follows, the data will be drawn wherever possible from the preliminary reports of the 1950 census of population, or from intercensal series which have been adjusted for the 1950 count. As the results of the Seventeenth Census are only partially available at the time of writing, and would not in themselves satisfy all purposes, earlier unadjusted estimates will have to be used in most instances. The occasional sample surveys of the Bureau of the Census and the Division of Farm Population and Rural Life of the Bureau of Agricultural Economics are particularly valuable for the period under study, although the more recent estimates are themselves in process of considerable revision in light of the bench-mark data supplied by the 1950 census and the redefinition of census categories required by rapidly changing residence-occupation characteristics.

pendent forces powerful enough to result in whatever labor displacement is necessary to make the use of machines effective and profitable?

As part of a larger study of the process of cotton mechanization the writer examined published statistics on population movements, employment, and farm wage rates during the decade 1940-1950 in an attempt to determine the extent to which a condition of labor scarcity might have influenced the accelerated mechanization of cotton farms in the South.[2] In this connection it must be borne in mind that many other factors affect the rate of introduction of machines besides the relative abundance of hand labor. One of these is the availability of practical mechanical alternatives to hand methods. In the case of cotton a dual production bottleneck has existed: hand labor has been needed both for weeding and harvesting the crop. To mechanize the harvest alone would therefore not completely relieve the need for substantial quantities of seasonal labor in the humid parts of the region. Cotton picking machines of the spindle type did not enter quantity production until after 1946, and the control of weeds by means of mechanical and flame cultivation and the use of chemical herbicides is even yet not fully reliable. Nevertheless, as will be indicated below, transitional adjustments may be made well in advance of the achievement of full mechanization, and these may have important effects on the conditions of farm employment.

Additional factors which affect the rate of mechanization are the adequacy of credit facilities, the size and typography of farm units, forces of custom and inertia, and other institutional aspects of the cotton economy which are beyond the scope of the present paper.[3]

Factors Affecting the Farm Population

Military mobilization during the war drew over four million men from all parts of the South, a large proportion of whom came from the farms. Yet as a reduction in the labor force this movement was clearly temporary. Had this been the principal influence on the supply of farm labor, the resulting manpower deficit could have been offset without great difficulty by the more effective use of the remaining manpower and other resources. However, there have been other major influences: population movements to other regions, movements from farms to towns and cities within the region, and the offsetting effect of the high rate of natural increase.

---

[2] Western irrigated cotton is excluded from this survey because of the special conditions prevailing in the areas concerned and the difficulty of securing relevant data from published sources.

[3] A discussion of these factors, as well as a description of the introduction of innovations in cotton production, are included in the larger study referred to; the present paper is limited to the relationship of labor stringency to the mechanization process.

Interregional Migration

The war years witnessed an upsurge of interstate and interregional population movements which were already under way during the last half of the '30's. These movements were generally consistent with the characteristic long-term shifts of population from farms to cities, from the Deep South to the border states, and from the South to other regions, which had been temporarily arrested during the trough of the depression. A sample survey conducted by the Bureau of the Census in March 1945, revealed a marked increase in net civilian migration from the sixteen states of the Census South to the eleven states comprising the West, during the war period from December 7, 1941, to March 1945, as compared with the prewar period from April 1, 1935, to April 1, 1940.[4] There was also an appreciable increase in net movement to the North Central Division, while a total movements to and from the Northeastern states were relatively small.

Concealed within these broad flows there occurred particular streams of migration for which information is incomplete but which probably had special significance for the labor supply in the Cotton Belt. Among the more important of these is the movement of the Negro farm population historically associated with cotton raising. Of the total population of 12,866,000 Negroes in the United States in 1940, 9,905,000 were in the Census South, and of these, 4,422,000, or 34 percent of the total, were on farms. By 1950 the total Negro population had grown to an estimated 14,893,000, but the number in the South remained almost stationary, and the number on southern farms had severely declined to 3,129,000 or 21 percent of the total.[5]

Since the time of the first world war there has been a tendency for relatively greater numbers of Negroes than of white persons to leave the southern, and particularly the southeastern, states. This trend has been effecting a gradual change in the racial composition of the region and has tended to disperse extremely high concentrations of Negro population which have existed in some localities. During the depression decade the net loss in Negro population by migration from the Southeast was about

---

[4] U. S. Bureau of the Census, *Population—Special Reports.* "Civilian Migration in the United States: December 1941, to March 1945." Series P-S, No. 5, September 2, 1945.

[5] U.S. Bureau of the Census, *Sixteenth Census of the United States: 1940. Population, Characteristics of the Nonwhite Population by Race* (Washington: Government Printing Office, 1943), pp. 5, 14; *idem, 1950 Census of Population—Preliminary Reports.* "General Characteristics of the Population, by Regions, April 1, 1950." Series PC-7, No. 3, April 30, 1951, pp. 8, 12. The decline in the number of Negroes on farms is in part attributable to a change in the Census definition of farm residence. No precise estimate of the effect of the change in definition was available at the time of writing.

425,000.[6] The net loss in white population was less than 1,000 persons. A Census study of internal migration from 1935 to 1940 indicates, however, that the rate of Negro out-migration slowed down during the latter half of the decade and that the white inflow which had taken place during the most acute years of the depression was reversed by a growing outflow.[7]

While the rate of Negro migration continued to lag during the early years of the war, it caught up with the rate of white movement later. Negroes were more mobile during the late war and immediate postwar period, and traveled longer distances. They also tended to shift their points of destination. The Pacific States, which had attracted surprisingly few Negroes among the numerous in-migrants of the 1930's (possibly because of the long travel distances from the Southeast), experienced a considerable influx of southern nonwhites during the war. Five congested production areas on the West Coast showed a combined increase of 213 percent in Negro population between 1940 and 1944.[8]

In interpreting the differential rates of population movement as between southern whites and nonwhites, the primary factor influencing Negro migration from the South during the first half of the 1930's seems to have been the "push" of displacement by mechanization and the operation of the A.A.A. program, low economic opportunity, and competition with white population returning to farms. Later, with partial recovery, the first opportunities at nonfarm employment tended to go to white persons, who resumed their normal pattern of outflow. It was only secondarily, and after acute manpower stringencies had developed in the industrial cities, that southern Negroes experienced a strong "pull," and that the rate of Negro outflow began to catch up.

Of course push and pull factors are operative at all times, and it is only the degree of relative importance which is here emphasized. In focusing attention on the increasing interregional mobility of southern Negroes in recent years it must not be overlooked that for the overwhelming majority there has not been sufficient attraction outside, or dissatisfaction with conditions within, to lead to the rather drastic step of a long-distance move into another region. The inertia factors accounting for geographic immobility remain strong, and changes in relative eco-

---

[6] Rupert B. Vance, *All These People* (Chapel Hill: University of North Carolina Press, 1945), p. 117. The states included by Vance in the Southeast are Virginia, North and South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, and Louisiana.

[7] U.S. Bureau of the Census, *Sixteenth Census of the United States: 1940. Population, Internal Migration, 1935 to 1940,* (Washington: Government Printing Office, 1943), p. 19.

[8] Henry S. Shryock, Jr., and Hope Tisdale Eldridge, "Internal Migration in Peace and War," *American Sociological Review,* Vol. 12, No. 1 (February, 1947), p. 32.

nomic opportunities in local areas and nearby urban communities have undoubtedly played a much greater role in inducing occupational shifts than the opportunities requiring long-distance moves and unusual sources of information.

Urbanization Within the South

In addition to interregional migration, therefore, the second and probably more important factor influencing the farm population and labor supply in the Cotton Belt has been the rapid growth of urban communities within the region. Here again a trend already evident before the war was continued and accelerated. In contrast with the more densely populated regions of the United States, whose cities failed to maintain their earlier rates of growth during the thirties, the southern region showed vigorous gains in city population throughout the period. During the forties the South continued to lead the Northeast and North Central states in rates of urbanization, but the greatest rate of increase within the region shifted from the South Atlantic to the West South Central states.[9] While urban population increased by 7 percent in the Northeast and by 15 percent in the North Central states from 1940 to 1950, it increased by 35 percent in the South. For the West South Central states alone the increase in urban population was 47 percent.

The growth in southern cities during the war years is the more striking when we remember that in this period civilian population as a whole was declining. From the registration for Ration Book Four in November, 1943, it has been estimated that the total civilian population in the South declined by 1,422,000 between 1940 and the end of 1943.[10] Yet of the 48 metropolitan areas in the South, 39 gained in population by the end of 1943. Most of the gains were in seaport and shipbuilding areas. Savannah grew 29 percent, Charleston 37 percent, Norfolk 57 percent, and Mobile 61 percent.

In the cotton states, the localities experiencing the heaviest drains of population were rural counties in Oklahoma and Texas (except for the High Plains, which showed surprising gains), the hilly areas of Arkansas, Mississippi, and Alabama, and the coastal plains of southern Alabama, Georgia, and South Carolina. The alluvial areas in general had smaller declines, and the western irrigated areas actually experienced increases, although there are indications that this trend did not persist throughout

[9] Vance, *op. cit.*, p. 35; U. S. Bureau of the Census, *1950 Census of Population—Preliminary Counts*, "Population of the United States, Urban and Rural, by States, April 1, 1950." Series PC-3, No. 10 (February 16, 1951), p. 7. Comparisons based on 1940 Census definition of urban population.

[10] U. S. Bureau of the Census, *Population—Special Reports*, "Estimated Civilian Population of the United States, by Counties: November 1, 1943." Series P-44, No. 3 (February 15, 1944), pp. 2-5.

the entire war, and that it did not necessarily benefit employers seeking cotton labor.

The Net Decline in Farm Population

As has been mentioned earlier, the farm population in the Census South decreased one-fifth from 1940 to 1945. Within the region, the West South Central division had the highest rate of decline, losing a fourth of its farm population.[11] In the other two southern divisions the loss was between a fifth and a sixth of the 1940 population.

By the end of 1945 a return movement of farm population had begun to set in, in which military demobilization and the reduction of employment on war production were important factors. How permanent was the decline in farm population occasioned by the upheaval of the war to be, after things settled down? This was a question creating some concern as the war drew to a close, since it was recalled that in the Middle West during the first world war the transformation in methods of wheat raising, followed by a collapse of wartime demand, had left many returning servicemen without employment.

As is now generally known, the postwar "Back to the Farm" movement lasted less than two years, from the end of the war until about the end of 1946. For the country as a whole it is estimated that three of every four farm men who went to war returned to farming by January 1, 1947, but many of those who returned did not stay long.[12] By the beginning of 1947 the South Atlantic and East South Central States had regained about three-fourths of their losses of farm population since 1940, and the West South Central States somewhat less than one-third.

In 1947, with the continuation of favorable employment opportunities off the farm, the normal trend of rural-urban outflow returned. In the East and West South Central divisions the loss through migration during 1947 and 1948 was sufficient to overbalance an unusually high rate of natural increase, and the farm population once more declined. In the South Atlantic States, however, the reverse was true. The high rate of natural increase was largely made up of the postwar surge in the number of births, but was also partly the outcome of a significant decline in the deathrate.

For the South as a whole the farm population showed a net decrease of just under ten percent, according to B.A.E. estimates, from 1940 to 1949.[13] In terms of the available farm labor force, however, the net loss was

[11] U. S. Department of Agriculture, *Agricultural Statistics*, 1948, p. 542.

[12] Margaret Jarman Hagood, "More People on Farms," *The Agricultural Situation*, Vol. 31, No. 9 (September, 1947), p. 2.

[13] Preliminary estimates based on the 1950 Census suggest that the decline for the full decade was probably considerably larger, but because of a change in the definition of farm population no strict comparison of the 1940 and 1950 Census figures by regions is possible at this time.

undoubtedly much greater, because those who remained on farms included a larger proportion of the very young.

Wartime and Postwar Changes in Farm Employment

In evaluating the degree of labor stringency experienced by southern farmers during the war, it would be useful to have adequate statistics on farm employment by significant areas within the South. The available data in the B.A.E. series are of rather limited value because of questions about sampling reliability and representativeness, and because of the concept of employment used, which makes no distinction between an underemployed worker who works only a few hours in a week and a fully employed worker.

With the qualifications noted, the data reveal a fairly continuous decline in farm employment in each of the principal cotton areas during the war years, with the exception of the moderately heavy crop year of 1942, when labor was still rather freely available. The decline in employment, especially among hired rather than family workers, was most noticeable in the Delta states of Mississippi, Arkansas, and Louisiana, where the use of hired workers showed a drop from 1940 to 1945 of 28 percent, and total employment fell 14 percent.[14] In the Eastern Cotton area, employment of hired workers declined 17 percent and total employment 8 percent during the same period; in the Western Cotton area, employment of hired workers declined 19 percent and total employment 9 percent.

In the immediate postwar years employment temporarily increased, though it failed to reach the levels of the recovery years before the war; and thereafter it continued to decline even during the unusually large crop year of 1949. For the entire decade from 1940 to 1950, the Eastern Cotton area showed a decline in total farm employment of 15 percent, the Delta area a decline of 17 percent, and the Western area a decline of 15 percent.

Difficulties in Evaluating the Labor Stringency

Notwithstanding the numerical loss of farm manpower which has been described, it is exceedingly difficult to arrive at a quantitative estimate of the acuteness of the labor stringency during the decade because of the complexity of qualifying factors which must be considered.

Unquestionably the most important of these, for which no adequate measure exists, was the substantial amount of unemployment and underemployment which existed in the region at the beginning of the war. As may be noted below in connection with the discussion of the initially sluggish movement of wartime farm wage rates, there are indications that enormous slack existed in farm production methods as they were

[14] Special breakdown prepared by Division of Special Farm Statistics, Bureau of Agricultural Economics. Total employment includes hired and family workers.

carried on before the war. Although farm operators found it hard to alter the customary methods of organizing farm work to which they were long habituated, many ultimately succeeded in getting along with considerably less help than before. One way was for individual farmers to cooperate more closely in swapping labor service and equipment; another was to hire on a custom basis equipment that had been under-utilized in the community before.

A second qualifying factor was the varying availability of alternative means of organizing the productive process, such as the substitution of machinery for labor, the increased use of fertilizer, and changes to less labor-intensive enterprises. Cotton acreages were sharply reduced in the latter years of the war. In some cases this reflected shifts to other enterprises, in others the temporary abandonment of land. After the war, when the price of cotton rose sharply, large plantings were rapidly resumed. A third and perhaps minor factor is the recent tendency of farm operators to concentrate their demand for labor within a shorter period than formerly. The increasing use of migrant labor for whose employment the operator feels no year-round responsibility, plus the desire to get the crop harvested with minimum loss, have contributed to keen competition for labor at the peak of the season.

The southwestern cotton areas which have made heavy use of migratory labor ever since the first world war suffered from a shortage of such workers during World War II because of increased employment opportunities in defense centers and transportation difficulties occasioned by gasoline and tire rationing. In August, 1942, the United States entered into an agreement with the Mexican Government to permit the importation of Mexican nationals under contract as emergency farm workers. At the peak of the Mexican labor program in 1945 over 60,000 workers were admitted, of whom 63 percent were employed in California.[15] This was by no means the limit of the influx, since many Mexicans entered this country illegally in search of similar job opportunities. The numbers of both legal and illegal entrants grew rapidly during the latter war years and afterward. In 1950 deportations and voluntary departures of illegal entrants—known as "wetbacks" because of the presumption that they have swum the Rio Grande—reached 565,000. It is assumed that the number actually in the country has been far in excess of this number.[16]

The Effect of the War on Farm Wage Rates

As will be apparent from the above discussion, the available statistics relating to the farm labor force are of only partial help in evaluating the

[15] The President's Commission on Migratory Labor, *Migratory Labor in American Agriculture* (Washington: Government Printing Office, 1951), pp. 37-39.
[16] *Ibid.*, pp. 69-70.

acuteness of the agricultural labor situation as a factor affecting mechanization. It is necessary to consider changes in wage rates as well. The complaint concerning a "labor shortage" frequently heard in agricultural localities around harvest time is often more of an expression of heightened anxiety about crop losses at this time and of unwillingness to meet competitive wage rates than of an actual condition of labor unavailability. The degree of increase in farm wage rates tends to serve as a test of competitive demands actually operating in the labor market and of farmers' earnestness in bidding for the available supply. This was particularly true during the war in view of the fact that, with limited exceptions, there were no ceilings placed on farm wage rates as there were on nonfarm wages.

Annual farm wage rates in the South nearly tripled from 1940 to 1945, and by 1948 were at least three and a half times what they had been before the war.[17] While the trend was similar in the United States as a whole, the annual rate of increase in the West South Central States exceeded the national average in every year of the war except 1945. The other southern divisions lagged in rate of increase during the first two years of the war, but by 1944 they were also exceeding the national average, and by 1948 had surpassed the accumulated rate of increase since 1939.

Average wage rates for picking cotton rose for the entire Cotton Belt from 62 cents per 100 pounds of seed cotton in 1940 to $1.93 in 1945, and to $2.90 in 1948, an increase of 368 percent from 1940.[18] The sharpest rises in picking rates during the war took place in the eastern seaboard states and in Texas, which had been relatively low-wage states before the war and which were directly affected by industrial activity in the seaport cities. By 1948, a large crop year, the pinch was being felt most keenly in the Delta states of Mississippi and Arkansas, where the picking rate per hundred rose to as much as 470 percent above the 1940 average. This no doubt reflected the large scale departure of Negro farm labor from these areas, and the inability to secure adequate replacements of Mexican labor from the Southwest.

---

[17] U. S. Bureau of Agricultural Economics, *Farm Labor,* December 11, 1950, pp. 9-13; *ibid.,* January 12, 1951, pp. 10-12. Serious questions, too extensive to be discussed here, have been raised regarding the reliability of the farm wage data on which the following discussion is based. Although the limitations of information gathered by the crop reporter system must be recognized, for the period under consideration the data cited are the most comprehensive, and therefore the most useful, available. Cf. R. F. Hale and R. L. Gastineau, *Reliability and Adequacy of Farm Wage Rate Data* (U.S.D.A. Agricultural Marketing Service, Washington, February, 1940); and Ivan M. Lee, "A Critical Evaluation of Available Agricultural Statistics," *Journal of the American Statistical Association,* Vol. 47, No. 258 (June, 1952), pp. 267-80.

[18] *Farm Labor,* November 10, 1950, p. 9.

The Preservation of Traditional Wage Differentials

Despite the large increases in farm wages which have been noted and some adjustments in relative rates in response to changing local conditions, the traditional differentials in wage payments by areas within the South were largely preserved. Among the southern geographic divisions, the East South Central states consistently show the lowest wage rates, and the West South Central states the highest. Among individual states, South Carolina has almost invariably afforded the lowest wage, followed closely in order by Georgia and Alabama; and this has remained true in the postwar years.

The most noteworthy change in the regional wage pattern appears to have been the emergence of the Delta area, from the Bootheel of Missouri to Northeastern Louisiana, as a relatively high-wage district, and this may turn out to have special significance for the mechanization of cotton production as it is in this locality that some of the most active experimentation with newer methods of agriculture has recently taken place.

Not only were customary wage differentials within the region preserved, but the South as a whole undisputedly remained the region of lowest farm wages in the country at the end of the war. The South Atlantic and West South Central divisions had narrowed the relative disparities somewhat, but in absolute terms the wage differences were still strikingly large. This may be roughly indicated by a comparison by geographic divisions of average monthly farm wages in 1945:[19]

East South Central states	$54	West North Central states	$105
South Atlantic states	62	New England states	108
West South Central states	77	Mountain states	116
East North Central states	92	Pacific states	156
Middle Atlantic states	95		

The degree to which such wage differentials have enabled southern operators to meet their production problem by reliance on low-cost labor is conspicuously brought out by the B.A.E. finding that although farmers in the Cotton Belt used nearly a third of the total hired labor employed on American farms in 1945, they paid only about a fifth of the country's annual cash farm wage bill.[20]

Furthermore, when controls on nonfarm wages were lifted after the war, the disparities between competitive farm and nonfarm wage rates

[19] *Farm Labor*, December 11, 1950, pp. 9-13.

[20] U. S. Bureau of Agricultural Economics, *Wages by Type of Farm and Type of Farm Work, United States and Major Type-of-Farming Regions, 1945*, Washington, July, 1947, p. 32.

which had been narrowed during the war were soon virtually restored by the tendency of nonfarm wages to spurt upward more rapidly.

Changes in Tenure Relationships

Farm operators in the older cotton region have in recent times shown unusual readiness to shift from a sharecrop to a hired labor basis in operating their farms, or the reverse, as the current season's advantage seemed to lie. Some of the changes in tenure relationships which took place during the war had special significance in their effect on the stability of the labor force and hence on the degree of urgency with which operators might consider mechanization.

In the prewar years a great many operators changed from a sharecrop to a wage system to avoid sharing parity payments with croppers. Under wartime conditions, however, many employers reverted to the traditional method of holding their labor by again offering a share of the crop. Thus, while the war fostered an increase in farm ownership and a general decline in farm tenancy, including a drop of over 94,000 in the number of cropper-operated farms in the South, the principal decline in tenancy was concentrated among classes other than sharecroppers. In North Carolina and South Carolina the number of croppers temporarily increased during this period.

Between 1940 and 1945 the number of white croppers in the Census South declined by 27 percent, while nonwhite croppers declined by only 10 percent, the difference no doubt reflecting the greater opportunity for nonfarm employment for the whites, and possibly the greater preference of farm owners for Negro workers. Within the region the changes varied considerably by states and by local areas. Although every state showed a decline in the number of white croppers, five states showed an increase in nonwhite croppers. The increases were concentrated in the seaboard states of North Carolina, South Carolina, and Georgia, where farm owners were apparently most successful in using the offer of a sharecrop as a means of retaining their Negro labor.

The wartime decreases in numbers of nonwhite croppers occurred almost wholly in one contiguous area extending from central Alabama across Mississippi, Arkansas, and Louisiana into eastern Oklahoma and Texas, while the increases occurred in a similarly contiguous area of the upper Coastal plains and parts of the Piedmont of the Carolinas and Georgia, where peanuts and tobacco as well as cotton are grown.[21] It is

---

[21] U. S. Bureau of the Census and Bureau of Agricultural Economics, *Graphic Summary of Farm Tenure in the United States* (Washington: Government Printing Office, 1948), pp. 18-19.

noteworthy that the former areas are in general more productive cotton lands and are better adapted to mechanization than the latter; hence the heavy decline in the number of sharpcroppers came in the areas where mechanization was most likely to offer a feasible alternative.

In the postwar years the decline in the number of sharecroppers continued at an increased rate. The estimated decrease in cropper-operated farms in the Census South from 1945 to 1950 was 100,000, or 36 percent.[22]

Transitional Tenure Arrangements Associated with Mechanization

Some significant changes in tenure arrangements which reflect the transitional stages of cotton mechanization have recently taken place in the South. Unfortunately the extent of these changes is not ascertainable from the Census reports and little descriptive material exists detailing the variety of arrangements which individual farm operators have devised as a means of easing the introduction of machinery.

In the Mississippi Delta during the thirties a cropper-wage type of arrangement emerged under which a cropper family was given a small sharecrop, insufficient to provide adequate income for the year, but sufficient to induce the family to remain located on a given farm and to see the crop through. For the remainder of its income the family was dependent on work for day wages. This arrangement had the advantage for the employer in that it provided stability of the labor supply while not obligating him to provide continuous employment for the entire force, and thus it lent flexibility to his operations as mechanization was being introduced on an experimental basis.

As labor conditions became more stringent during the war, the sharecrop, sometimes as small as three acres of cotton, would often be assigned to the wife of the sharecropper, who as the mother of small children was usually the most immobile member of the family. She would thus be induced to stay for the security provided by the sharecrop, with the expectation that the husband, who might leave for occasional defense jobs, would return from time to time and thus be available for part-time farm work on a wage basis. The introduction of the tractor-drawn plow as a replacement for the walking plow made the services of an adult male worker less essential than they would otherwise have been.

On some farms where partial mechanization was introduced the sharecrop system was retained and each cropper family was assigned a specific crop acreage, but instead of working this acreage in individual units, all workers on the plantation tended the common fields under a gang system directed by an overseer. This facilitated the use of tractors for ground

[22] U. S. Bureau of the Census, *Seventeenth Census of the United States: 1950*, preliminary release.

breaking and seedbed preparation, followed in some instances by mechanical planting and cultivation.

A variety of arrangements was worked out to compensate the operator for the increased input costs which had formerly been part of the manual contribution of the cropper. Many planters began to charge their croppers service fees for the operations performed with power equipment. Others shifted from the traditional 50-50 to a 60-40 share basis, under which the operator paid for all seed, fertilizer, and poison, and received in return 60 percent of the crops and 60 percent of the government benefit payments.

Under a third transitional arrangement the plantation labor force has been divided into two parts: (1) a basic crew sufficient to insure weed control, stabilized on the farm by being assured a sharecrop; and (2) the remainder of the employees, who are on a wage basis and whose employment fluctuates with the demands of the season and the year. The members of the latter group have little job security and are most readily detached as mechanization reduces the need for hand labor or as alternative opportunities pull them away from the farm.

In other parts of the Cotton Belt it is more difficult to find instances of significant transitional changes in tenure arrangements, partly because the process of mechanization has not been carried so far. One observer has estimated that on the coastal plain of South Carolina in the 1950 harvest season there were from 75 to 100 plantation operators with mechanical cotton pickers, each representing an investment of over $8,000, standing idle in their sheds while their cotton was being picked by hand. These unused machines were purchased as stand-by equipment in case of a labor shortage, and the interest and depreciation costs were charged off as insurance against a recurrence of difficulties experienced during the war.

Given both available machines and a plentiful supply of labor, as in 1950, planters prefer to have their cotton picked by hand, since it is then cleaner and higher in grade. More importantly, hand labor is still needed for weed control during the cultivation period, and it is feared that if displaced during the harvest, the fieldhands will disappear from the community. If an assured mechanical solution for the weed problem is developed total mechanization will become feasible and there will no doubt be labor displacement on the larger farms.

Another factor in the preference of planters for hand labor over machines appears to be the genuine concern which some of them feel for loyal employees of long standing. Some of the larger operators, of whom a few have 100 or more cropper families, are introducing fuller mechanization only on the land from which the tenants have departed, which may be as little as a tenth of the cotton acreage.

In the upland plains areas of the Southwest, where partial mechanization of cotton production was already under way during the late thirties, the war merely accelerated trends which were already visible, and there were few distinctive changes in tenure arrangements. A study by Robert T. McMillan based on Census data for Oklahoma counties from 1920 to 1945 showed that mechanization has been most advanced in the north central and western, or Low Plains, portion of the state, and has been associated with a decline in farm population, a decrease in the number of farms, and an increase in the average size of farm.[23] However, the rate of population loss from counties with the least mechanization, principally the hilly subsistence areas of Southeast Oklahoma, was nearly as large as in the most mechanized areas. This indicates that other factors, such as lack of economic opportunity on poor land, encouraged emigration during the period.

In the adjoining High Plains of Texas farming conditions are similar. In this area the mechanical cotton stripper was introduced rather rapidly during the late war years to offset the shortage of casual migratory labor on which farmers had previously depended. Interestingly enough it was the smaller farmers who showed the most interest in mechanical harvesting and who initially got the most benefit from it. The 30,000 to 35,000 workers who migrated into the High Plains area during the 1944 harvesting season (as compared with about 50,000 such workers employed there in 1942), were attracted to the larger farms, and farmers with 150 acres or less of cotton were compelled to seek other means to harvest their crops. These operators harvested the greater portion of their crop mechanically, many of them using crude sleds of home manufacture.

As the labor situation in the High Plains continued troublesome in following years, several manufacturers began to produce tractor-mounted strippers patterned after a model developed by the Texas Agricultural Experiment Station, and machine stripping became more common. Thus, while in 1944 local ginners estimated that 18 to 20 percent of the 500,000 bale crop was harvested with a rather limited number of mechanical devices, by 1949, a record crop year, between 5,500 and 6,000 factory-built strippers harvested about 575,000 bales, or 40 percent of the crop.[24]

One of the most significant aspects of the relatively inexpensive mechanical stripper is that, in the areas to which it is adapted, it may enable the small and moderate-sized cotton farm to survive as an efficient farm-

[23] *Social Aspects of Farm Mechanization in Oklahoma*, Oklahoma Agricultural Experiment Station, Bulletin B-339, Stillwater, November, 1949.

[24] Troy Mullins, *Harvesting Cotton in the High Plains of Texas*, Texas Agricultural Experiment Station, Progress Report 952, College Station, August, 1945, pp. 6-7; M. N. Williamson, Jr., Q. M. Morgan, and Ralph H. Rogers, *Economics of Mechanical Cotton Harvesting in the High Plains Cotton Area of Texas*, Texas Agricultural Experiment Station, Bulletin 735, College Station, June, 1951, p. 11.

ing unit by freeing the farm family from its former dependence on outside labor to harvest the cotton crop. This will of course affect the employment opportunities for migratory workers, who have been available in greater numbers in recent years.

Evaluation of the Wartime and Postwar Labor Situation

The foregoing discussion illustrates the complexity of supplying adequate statistically grounded answers to such questions as "How acute was the wartime labor shortage in the Cotton Belt?" and "To what extent has the postwar era revealed a significant redistribution of manpower relative to other resources in the cotton economy?" The answers to these questions appear to be crucial to an analysis of the factors affecting the rate of introduction of labor-saving machinery into the Cotton Belt, and yet, with the information at hand, they elude precise quantitative determination. Therefore we must be content with an evaluative judgment which can only roughly weigh the influences affecting the cotton labor supply.

To summarize, we may list the following general conclusions:

1. There was a substantial decline in southern farm population due to migration during the war, temporarily interrupted in the immediate postwar adjustment period, and since resumed. Movement of Negroes was prominent in this decline, although it was spotty and delayed in getting started.

2. Partially offsetting the streams of migration to the cities and out of the region have been the continuation of high rates of natural increase and, in the western portions of the Cotton Belt, an increased influx of unskilled labor from Mexico.

3. Farm employment figures, whose limited usefulness must be emphasized, indicate less of a labor drain from southern farms during the decade than the decline in farm population and the maintenance of high levels of urban employment would suggest. There has, however, been a marked decrease in the number of white sharecroppers and a moderate decrease in Negro croppers in the more productive cotton areas.

4. The response of farm wage rates, which rose much more rapidly than wage rates in competing nonfarm employment, and the return to the offer of a sharecrop, which was particularly noticeable in the low-wage area of the Southeast, indicate that hiring farmers felt the labor stringency acutely enough during and after the war to raise materially their inducements to labor to remain available for work on the farm. Substantially increased farm incomes made possible the offer of these inducements.

5. Nevertheless, the persistence of intraregional and interregional farm wage differentials, which were only slightly narrowed during the war,

and the preservation of wide differences between farm and nonfarm wage rates despite the existence of wartime ceilings on the latter, suggest that most farm employers in the South, and especially in the Southeast, did not feel a competitive demand for essential labor so acute as to establish a new wage position for southern farm labor relative to labor in other farming regions and in nonfarm employment.

6. The reconciliation of the relatively slight wage and employment effects, for southern agriculture as a whole, with the rather large departure of potential farm workers from the cotton areas can be made only by recognizing the enormous amount of slack which existed in the cotton economy before the war in the form of unemployed and underemployed workers using relatively inefficient farming methods. The availability of less labor-intensive alternatives also tended to relieve the severity of the labor problem.

7. Thus only in a few areas does it appear probable that the mechanization of cotton production has been a direct response to a condition of actual labor unavailability in relation to customary cropping methods. The wartime introduction of cotton strippers into the High Plains and the more recent conversions to mechanical picking in the Mississippi Delta and in California may represent such cases, but for most other areas in the Cotton Belt total mechanization will have to push its way in against relatively abundant manpower resources. This situation, although by no means as severe as it was during the thirties, nevertheless threatens to widen the disparities in production methods within the region and to preserve continual pressure to leave the farms on appreciable portions of the rural population.

Non-economic Factors Affecting Mechanization

Notwithstanding the above conclusions about the objective conditions, it is possible that the recent rise in wage rates and the repeated anticipation from year to year of labor difficulty has generated in the minds of a good many southern farmers a psychological "labor shortage" which has tended to make them more machinery-minded. The decision to mechanize is after all not altogether an economic one. Power equipment affords a certain amount of personal convenience, and there is the prestige of becoming a "progressive farmer" attached even to partial mechanization. In most cotton areas the tractor does not yet in fact relieve the bottlenecks in the production process—labor for chopping and labor for picking—but it is a symbol of eventual total mechanization which promises to ease these seasonal pinches when complementary equipment adapted to wide-scale use is developed.

For the war and postwar period as a whole the net reduction in south-

ern farm population undoubtedly brought about a more favorable adjustment of manpower to land resources, and by eliminating much of the slack it compelled cotton farmers to pay more attention to efficiency in the use of resources. The large wartime departure of people from the farms, even if the problems which it raised were only temporary, nevertheless had an important *permissive* effect in allowing long-needed changes to be undertaken. In this sense the population shifts facilitated the experimental adoption of new methods in some areas even though over a somewhat longer period the labor situation would not necessarily have forced farmers to change long-term habits of operation. This to some degree accounts for the unevenness of the progress of mechanization and alternative land-use adjustments in the South.

It is important to note in this connection that many of the adjustments which have taken place in response to the population movements of the last decade are unlikely to be reversed. Where alternative enterprises involving a considerable investment, such as certain types of livestock raising, have been adopted, or where total or even partial mechanization has been introduced, demanding farm replanning and the destruction of tenant houses as well as a substantial investment in equipment, it seems highly improbable that even a considerable economic depression would lead to a return to older, more labor-intensive practices in these areas. Extended experience in other industries and other farming regions indicates that though the machine may be long delayed, once it comes it seems to dominate the future development of the enterprise which employs it.

Notwithstanding these indications of economic progress, it is well to remember that for important areas of the South there remains an excess of population relative to the present capacity of the land resources to afford a standard of living comparable to that in other rural areas. Whether this condition will continue to improve is heavily dependent on whether nonagricultural pursuits can continue to siphon off the redundant population resulting from the highest natural replacement rates in the country.

HEDGING—HOW EFFECTIVE IS IT?[1]

TRUMAN F. GRAF
University of Wisconsin

SINCE prices are continuously fluctuating, marketing risks are inevitable. This is particularly true when stocks are accumulated or held over an extended period of time. Although theoretically, with no permanent change in supply and demand, the gains and losses from price changes could conceivably offset each other in the long run, nevertheless the individual merchant is not in a position to wait for these balancing forces to become effective. For instance, country elevators may hold grain for several weeks before disposing of it to terminal markets. Grain prices may well decline so drastically over a period of time that the operator's working capital is seriously depleted. Furthermore, the operator ordinarily varies the quantity of grain, and the time of holding it, so that even if price increases and declines exactly counterbalanced each other, gains and losses would still not be equalized. Businessmen who are primarily engaged in processing or distributing commodities are therefore anxious to avoid as fully as possible risks associated with price changes. This they do by shifting the risks to others who are willing and able to assume them. Hedging is theoretically one method of accomplishing this.

The protective feature of hedging is based on the assumption that trends in cash and futures prices are sufficiently similar, so that losses incurred in the purchase or sale of cash commodities can be offset by gains from opposite transactions on the futures markets. When movements of cash and futures prices are parallel, those who hedge the purchase of cash grain by offsetting sales of futures contracts, will lose on the cash commodities as prices decline, but these losses will be counterbalanced by gains on futures contracts. When cash prices advance, the reverse is true. If futures and cash prices do not parallel each other, however, losses on cash may be accompanied by losses on futures. For instance, if after the hedge is made, cash prices fall and futures prices rise, the elevator operator who hedges cash purchases against future sales, not only loses money, but actually loses more by hedging than by not hedging. It is necessary therefore, in evaluating the effectiveness of hedging, to examine the relationship between cash and futures prices over time. From this

[1] The author wishes to acknowledge the useful criticism of R. G. Bressler of the University of California, Willard W. Cochrane of the University of Minnesota, and Henry H. Bakken, Robert L. Clodius, Hugh L. Cook, Harlow W. Halvorson, Marvin A. Schaars, and Sydney D. Staniforth of the University of Wisconsin. Errors in fact or judgment, however, are the sole responsibility of the author.

examination, conclusions can be reached on the practical value of the futures market as a hedging device.

The present study is concerned with this problem and has two major objectives. They are: (1) to examine the need for hedging, and (2) to examine the effectiveness of hedging. The need for hedging results from cash price changes. The extent of cash price changes over 4, 8, and 16 week periods, was therefore calculated. The effectiveness of hedging is determined by the degree to which it reduces the risks arising out of cash price fluctuations. A determination of this nature was made by analyzing the hedges which could have been effectuated at the close of trading each Friday during the years 1949–51.

Methodology

Results in this study are based on an analysis of data for wheat, corn and oats at the Chicago Board of Trade during the years 1949–51. These three grains outrank all other grains nationally in volume of production, and rank 1, 3, and 4 in volume of futures trading on contracts markets. Soybeans, ranked second in volume of trading on the Chicago Board of Trade. However, because trading in soybeans was predominantly speculative and partially because complete cash quotations were unavailable, soybeans were not included in the analysis.

Data from the Chicago Board of Trade were selected because the volume of trading on this contract market was larger than on any other. Furthermore, there is no evidence to indicate that the cash-futures price relationships on the Chicago market were greatly different from those existing on other markets.[2]

The years 1949–51 were selected because this period includes 18 months of peace, and 18 months of war. Hence stable and falling prices, as well as rising prices occurred.

Cash price quotations compiled by the Market News and Service Division for Friday of each week were used. Quoted prices are of course not necessarily prices of actual sales because frequently no cash sales occur on the floor of the Board of Trade. On these days the quoted price is a nominal or estimated price made by competent market analyses. It is a price which, in the best judgment of individuals close to the grain business, would have prevailed if a sale had taken place. Use of these quoted prices rather than the prices of actual sales have three advantages. First, they are always available for the same grade; second, quoted prices are likely to reflect a more uniform quality in the grade; third, it is possible to obtain a complete price series which is not the case for actual sales transactions. The last reason is valid, of course, only if the quoted prices are otherwise

[2] L. D. Howell, *Analysis of Hedging and Other Operations in Grain Futures*, USDA Technical Bulletin No. 971 (August 1948).

reliable indicators of market values, which it is believed they are.

The cash prices used were for No. 2 hard winter wheat, No. 3 yellow corn, and No. 2 white oats. Although these grades of wheat and oats are deliverable at contract prices, No. 3 yellow corn is deliverable at two cents under the futures price. Because contracts for maturing futures are only infrequently fulfilled by actual delivery of grain, it did not seem as essential to use grades deliverable at the contract price as it was to use grades actually moving through the market in sizeable quantities. These three grades are ordinarily in the longest supply.

The futures price quotations used were those existing at the close of trading on Friday of each week. When no trading occurred on Friday, the prices for Thursday were used. As indicated earlier, cash prices for the same day were used. Hence, the hedges analyzed in these reports are the ones which could have been effected at the close of trading each Friday. It is recognized that complete justice cannot be done by evaluating hedging effectiveness during one moment each week. However, the very magnitude of the data dictates the necessity for an averaging technique, and since quotations on Friday are thought to represent a fairly typical cross section of the prices for the week,[3] this moment was used.

Merchants who are adept in predicting price changes will be able to get more protection than will be indicated by hedges initiated at the same moment of time, week in and week out over a three-year period. Dealers are speculating and not hedging, however, when they begin to estimate price changes. For instance, Stewart found that almost 60% of the wheat hedgers sustained losses because "the operations of those assumed to be hedgers included some speculative transactions."[4] In other words, not only are merchants who attempt to "guess the market" defeating the very purpose of the hedge, but actually they seem to be losing money by doing so. An effective futures market should provide price protection at the time when the merchant makes his cash transactions. He should not have to "play the market" to make effective hedges.

All hedging was assumed to be done on near-month futures, with eight week hedges prevailing in all situations.[5] In other words, if an elevator operator wished to hedge cash wheat on April 8, 1949, he would have dealt in the July and not the May future. On the other hand, if the hedge had been effectuated on March 25, 1949, a May future would have been purchased.[6] The near-month future was used because "normally the

[3] Howell, *Op. cit.*, p. 4.

[4] Blair Stewart, *An Analysis of Speculative Trading in Grain Futures*, USDA Technical Bulletin 1001 (October, 1949), pp. 58–59.

[5] Commission and carrying costs of cash grain and other expenses associated with hedging were not taken into account. Incorporation of these data would only have served to complicate and not improve the analysis.

[6] It would be possible to hedge over an eight week period in a future which had

nearby future can be expected to follow more closely the current cash prices."[7] An eight week hedge was used in preference to a hedge of a shorter duration because country elevators hedge on the average 45 days or six and one-half weeks.[8]

Price Variability

Before determining the effectiveness of hedging in reducing the risk arising out of price variability, it is necessary to determine whether or not considerable price variability really exists. Cash price changes for all three grains were found to be substantial and persistent over both short and long periods of time. For example, wheat prices went up or down ten cents or more a bushel 25% of the time over four week periods, 38% of the time over eight week periods, and 53% of the time over 16 week periods.[9] In corn a change of this magnitude occurred 13% of the time over four week periods, 28% of the time over eight week periods, and 34% of the time over 16 week periods. For oats the figures were 5%, 17%, and 45%. The average change in price over 8 week periods during 1949-51, was 9.45¢ for wheat, 6.91¢ for corn and 6.20¢ for oats.

These changes offset each other to a certain extent. In wheat, for instance, cash prices increased on the average, 56% of the time over four week periods, 59% of the time over eight week periods, and 58% of the time over 16 week periods. Decreases occurred 42%, 41%, and 42% of the time.[10] On the average then, it appears that the firm would have profited more often than it would have lost. Losses, however, may well have resulted in bankruptcy, had forced selling been necessary. The balancing of losses and gains would seem to be outweighed by the sizeable price declines which frequently reached 25 cents a bushel. Although price increases of this magnitude also occurred, losses of 25¢ a bushel are too large for the average firm to absorb over even the short run.

---

less than eight weeks to run. This could be accomplished by buying (or selling) the future at its maturity date and immediately making an offsetting transaction on the next near month future. This involves spreading, however, and would serve to complicate the present analysis.

[7] J. M. Mehl, *Hedging in Grain Futures*, USDA Circular No. 151 (June, 1931), p. 22.

[8] *Ibid.*, pp. 52-53.

[9] Cash prices for each Friday compared to cash prices four, eight, and sixteen weeks later.

[10] Cash price increases in corn occurred 59% of the time over four week periods, 62% of the time over eight week periods, and 73% of the time over 16 week periods. In oats the figures were 55%, 58%, and 56%. On only 4 occasions did the price remain unchanged (once in wheat over 4 week periods, once in corn over 4 week periods, once in corn over 8 week periods, and once in oats over 8 week periods). If prices had been adjusted to the nearest whole number rather than carried to eighths of a cent a bushel, the number of unchanged situations would of course have been greater.

TABLE 1. EFFECTIVENESS OF HEDGING ON NEAR OR SECOND NEAR MONTH FUTURES AT CHICAGO OVER 8 WEEK PERIODS, IN SPECIFIED SEASONS, 1949–51[a]

Season	1949	1950	1951	1949–51
	% of Effectiveness	% of Effectiveness	% of Effectiveness	Average % of Effectiveness
		Wheat		
July-Aug.	56.05	67.48	59.33	60.42
Sept.-Nov.	48.07	53.70	75.26	58.82
Dec.-April	6.99	14.36	64.79	20.61
May-June	−34.31[b]	33.99	51.27	2.60
Average[c]	9.35	35.71	65.60	35.58[d]
		Corn		
July-Aug.	29.48	−135.13[b]	90.98	−15.58[b]
Sept.-Nov.	21.81	26.71	23.47	23.75
Dec.-April	6.90	71.77	7.64	36.12
May-June	47.50	53.14	56.47	53.17
Average[c]	22.60	46.11	8.87	26.68[d]
		Oats		
July-Aug.	33.35	19.88	60.17	39.79
Sept.-Nov.	61.33	87.28	67.82	74.63
Dec.-April	37.49	64.95	31.96	47.20
May-June	−114.98[b]	−12.21[b]	57.99	−2.58[b]
Average[c]	21.92	48.06	54.88	41.00[d]

[a] Effectiveness of hedging refers to the percentage decrease in gains or losses accomplished by hedging.

[b] These figures indicate the percentage increase in gains or losses resulting from hedging. They indicate that not only has the hedge failed to reduce gains or losses, but has actually increased them by the appropriate figure.

[c] A weighted average reflecting the average of both the effective and ineffective hedges.

[d] Average of yearly averages and weighted by the number of hedges each year (52 in 1949, 52 in 1950, and 45 in 1951).

Hedging Effectiveness

Although the marketing system can do little to directly reduce the price fluctuations previously indicated, nevertheless, through the process of hedging, risks due to price fluctuations can theoretically be reduced. Hedging is accomplished by offsetting the purchase, or sales of a commodity, by the sales or purchases of an equivalent quantity of futures contracts. To the extent that future and cash prices parallel each other, risks associated with price change can be removed, because losses on cash purchases can be exactly offset by gains on the futures transactions. The purpose of hedging then is to remove the risk resulting from changes in the cash prices, between the time of purchase and time of sale. Hence, hedges were analyzed in terms of their departure from the no gain, no loss position. More specifically, the effectiveness of hedging in reducing the risks associated with price variability, was determined by computing the extent to which gains or losses on unhedged grain could have been reduced by hedging.[11] These data are presented in Table 1.

[11] If for example, cash prices went down 10¢ a bushel between the time an elevator operator bought and sold the grain, his losses exclusive of the operating margin would

These data indicate that, with the exception of corn, hedges had their maximum effectiveness during and immediately following the periods of harvest, that is, during the time that considerable hedging takes place. For the three year period, hedges in wheat were 60% effective during July and August, 59% effective during September-November, and only 22% and 3% effective during December-April and May-June. In oats maximum effectiveness of 75% occurred during the September-November period. Hedges were 40% and 47% effective during the July-August period and December-April period, and actually were ineffective (or increased gains or losses) by 3% in the May-June period. In corn considerable scatter occurred with a high of 53% effectiveness in May-June and a low of 16% ineffectiveness in July-August.

The low hedging effectiveness of 9% for wheat, 23% for corn, and 22% for oats in 1949 was largely responsible for the low average effectiveness of 36%, 27%, and 41% over the three-year period. With the exception of corn in 1951, the effectiveness of hedges greatly increased each year, an increase which coincided with the decrease in price support activity.[12]

The Degree of Effectiveness

The number of effective hedges having various degrees of effectiveness are presented in Table 2.[13] Three important facts emerge from the data in

---

have also been 10¢ a bushel. If by hedging the loss could have been reduced to 1¢ a bushel the hedge would have been classified as 90% effective, while a loss of 5¢ would have been associated with a 50% effective hedge. Similarly if cash prices had gone up 10¢ a bushel between the time of purchase and sale, gains exclusive of the operating margin would also have been 10¢ a bushel. If by hedging, this gain would have been reduced to 1¢ a bushel, the hedge would have been classified as 90% effective, while a gain of 5¢ a bushel would have been associated with a 50% effective hedge. To be effective, then, hedges must reduce gains as well as losses to long basis hedgers (buy cash—sell futures). If the gains to long basis hedgers were not reduced, then the short basis hedgers (sell cash—buy futures) would receive no protection. For instance, if cash prices rose 10¢ a bushel and futures prices remains unchanged, the long basis hedger would of course make 10¢, whereas if the futures prices also rose 10¢ he would make nothing. At first glance then it would appear that the first hedge was the most effective. Actually, however, just the reverse is true, because in the first case a short basis hedger (sell cash—buy futures) would have lost 10¢ a bushel, while in the second case he would have lost nothing. Thus it is only in the second case that the hedge affords protection to both the long and short basis hedger. In the first case where the long basis hedger made 10¢ the short basis hedger lost 10¢. Thus the hedge did not fulfill its function to one-half of the potential hedgers. To be 100% effective then, to both long and short basis hedgers, the hedge must result in neither a gain nor a loss.

[12] Loans under the wheat price support program decreased from 335.3 million bushels in 1949 to 188.4 in 1950, and 199.6 in 1951. In corn the figures were 331.5 million bushels in 1949, 51.6 in 1950 and 25.3 in 1951, and in oats the decrease was from 30.4 million bushels in 1949 to 14.6 in 1950, and 12.9 in 1951. Thus with the exception of wheat, loans decreased each year from 1949 to 1951. Even in wheat the increase from 1950 to '51 was only about 5%.

[13] Data in this table refers only to the effective and not the ineffective hedges. This separation makes it possible to determine specifically how effective the effective hedges

TABLE 2. THE NUMBER OF EFFECTIVE EIGHT WEEK HEDGES ON NEAR OR SECOND NEAR MONTH FUTURES AT CHICAGO HAVING VARIOUS DEGREES OF EFFECTIVENESS, 1949–51[a]

Per Cent Effectiveness	1949		1950		1951	
	Number	Average Per Cent Effectiveness	Number	Average Per Cent Effectiveness	Number[a]	Average Per Cent Effectiveness
			Wheat[b]			
0– 24	7	10.00	7	10.43	1	12.00
25– 49	13	35.23	10	37.70	4	39.00
50– 74	10	58.20	16	59.63	8	65.88
75–100	4	83.50	9	87.00	19	89.63
Average		42.47		52.07		74.93
			Corn[b]			
0– 24	5	8.60	3	11.66	4	9.25
25– 49	10	38.30	7	40.43	8	35.63
50– 74	11	63.18	11	62.55	7	59.00
75–100	8	88.88	16	90.69	9	85.56
Average		53.88		66.40		53.75
			Oats[b]			
0– 24	1	14.00	9	10.78	2	12.50
25– 49	8	36.63	5	36.20	3	40.67
50– 74	10	59.20	9	64.78	19	62.47
75–100	12	88.58	19	88.84	12	88.75
Average		63.29		62.17		66.64

[a] There were a total of only 45 hedges in 1951. This was because all hedges covered eight weeks, and since no data were available for 1952, there could naturally be no hedges analyzed during the last 7 weeks of 1951.

[b] Since there were a total of 52 hedges in 1949 and 1950, and 45 in 1951, the percentage of effective hedges can be determined by adding up the number of hedges listed in this table in any year and dividing by the total number in that year. Thus in 1949 only 34 out of the 52 wheat hedges were effective. 65% of the hedges were therefore effective and 35% ineffective.

this table. (1) The number of hedges having a high per cent of effectiveness generally increased between 1949 and 1951. Thus in 1949 only about 25% of the wheat hedges were 50% or more effective, while in 1951 over 60% of the hedges had this degree of effectiveness. In oats the increase was from 40 to 70%, while in corn no increase or decrease occurred.

(2) The average effectiveness of these effective hedges did not vary greatly during the period. Although effective wheat hedges increased in effectiveness from 43% to 75%, corn hedges stayed the same (53%) and oat hedges increased only from 63% to 67%. It must be concluded, therefore, that the general increase in hedging effectiveness noted earlier, resulted from a decrease in the ineffectiveness of ineffective hedges, rather than an increase in effectiveness of effective hedges. In other words, the promi-

actually were. As will be recalled from Table 1, the average effectiveness of hedges was only a little over 30%. However, even with this low effectiveness it is possible that on the whole hedges would perform a useful function if (a) a large proportion of the hedges are effective rather than ineffective, and (b) the effective hedges have a high degree of effectiveness. If on the other hand, it is found that a large number of ineffective hedges occur, and that the effectiveness of even the effective hedges is not particularly high, then it can be concluded, that on the average hedging does not provide continuous and substantial protection against risks associated with price changes.

nence of situations where greater losses were incurred by hedging, than by not hedging, decreased over the three year period.

(3) Although in general there were more hedges having a high per cent of effectiveness in 1951 than in 1949, nevertheless, there were still a disturbingly large number of hedges offering little protection. Of the hedges analyzed in this study, only 70% were effective in the year of 1951. Furthermore, one-quarter of these were less than 50% effective.

Gain or Loss Per Bushel on Hedged Compared to Unhedged Transactions

Data in Tables 1 and 2 made no distinction between hedges on which gains were made, and hedges on which losses were suffered. This is because the effectiveness of hedging was measured by the degree to which it permitted the hedger to maintain a no profit-no loss position. The average hedger, however, is more interested in his returns per bushel by hedging, compared to his returns per bushel by not hedging. The gain or loss per bushel on hedged transactions compared to the gain or loss per bushel on unhedged transactions is therefore presented in Table 3.[14]

TABLE 3. THE AVERAGE GAIN OR LOSS PER BUSHEL ASSOCIATED WITH USING THE HEDGE OVER NOT USING THE HEDGE, ON LONG BASIS POSITIONS, AT CHICAGO OVER EIGHT WEEK PERIODS, BY SEASONS, 1949–51[a]

Season	Wheat			Corn			Oats		
	1949	1950	1951	1949	1950	1951	1949	1950	1951
	Gain or loss resulting from using the hedge over not using the hedge								
	(*Cents*)								
July-Aug.	−5.19	+4.34	−5.40	+1.15	− 2.48	−8.26	−3.23	−3.00	−4.11
Sept.-Nov.	−3.57	−6.70	−9.98	−6.06	−11.30	−9.55	−4.80	−8.38	−6.84
Dec.-Apr.	−0.19	−9.56	+4.95	+2.44	− 8.90	+3.84	+2.04	−6.41	+5.57
May-June	−6.33	−6.58	+5.38	−4.12	− 6.46	+2.51	−4.63	−1.78	+6.29
Average[b]	−2.84	−6.19	−0.35	−0.92	− 8.08	−1.82	−1.51	−5.57	+1.01

[a] Long basis positions refer to the purchase of cash grain, hedged by the sale of futures contracts.
[b] Weighted by the number of hedges in each particular season.

If cash prices increase constantly, then in all probability non-hedgers would profit relative to long basis hedgers. Similarly if cash prices declined steadily, long basis hedgers would profit relative to non-hedgers. However, when price decreases occur about as frequently as price increases do, the persistence of either consistent gains or losses to hedgers has considerable significance.

When the data are grouped into seasons (July-August, September-November, December-April, and May-June), it is found that during the three-year period, wheat and oats hedgers lost relative to non-hedgers

[14] Thus if because of a cash price decline, a non-hedger lost 10¢ a bushel while the long basis hedger lost only 2¢ a bushel, the hedger actually "gained" 8¢ a bushel over the non-hedger. On the other hand, if because of a price rise, the non-hedger realized a profit of 10¢ a bushel, while the long basis hedger made only 2¢, then the non-hedger "gained" 8¢ a bushel over the hedger.

during 9 out of the 12 seasons, and corn hedgers lost during 8 out of 12 seasons. Corn hedgers could have saved as much as 11.3¢ a bushel by not hedging (September-November 1950). The average for the year was 8.08¢. The largest gain 6.29¢, registered by hedgers over non-hedgers occurred in oats (May-June 1951). In the period under study non-hedgers made about three cents more per bushel than did the wheat, corn, and oats hedgers. Wheat and corn hedgers lost relative to non-hedgers in all three years, while oats hedgers lost in two out of three years.

This rather surprising indictment of hedging is alleviated somewhat when the nature of the gains or losses from hedging, relative to non-hedging are analyzed. In wheat, gains or losses of hedgers relative to non-hedgers were reduced in 8 out of the 12 seasons, in corn 6 out of 12 seasons, and in oats 9 out of the 12 seasons. Apparently losses of hedgers compared to non-hedgers are attributable partly at least to a reduction in gains which result from cash price rises. This reduction in gain is the sign of an effective hedge. Gains in cash prices, however, occurred only 59% of the time in wheat, 64% of the time in corn, and 60% of the time in oats, over eight week periods, during 1949-51. Hence declines occurred almost 40% of the time. These declines should show up as losses to the non-hedgers and gains to the hedgers. Hence, the fact that some of the losses to hedgers relative to non-hedgers are attributable to an increase in cash prices (which occurred around 60% of the time) should be partially offset by the gains to hedgers resulting from a decline in prices. Since, however, hedgers consistently lost relative to non-hedgers, it must be concluded that hedging does not automatically become a profitable undertaking just because price increases and declines occur with the same frequency. Even though the number of price increases and decreases are about the same, the long basis hedger can lose relative to the non-hedger. This will occur if either (a) the magnitude of the cash price increases is greater than the magnitude of the declines, or (b) the cash price declines are accompanied by future price increases more frequently, and in a greater magnitude than cash price increases are accompanied by futures price declines. If these situations occur frequently (as they did during the period studied) hedging is not particularly profitable.[15]

Net Profit Uncertainty

The ultimate test of hedging is the extent to which it safeguards the firm's normal margin of profit on its commodity purchases and sales. A fairly precise approximation of this was made by calculating the price

[15] Losses of over 5¢ a bushel were incurred on 20% of the wheat and corn hedges, and on 10% of the oats hedges during the 1949–51 period. During 1949 close to 30% of the wheat and corn hedges and 15% of the oats hedges resulted in losses of this magnitude.

change removed by hedging as a percent of cash price. This measure was used because net profits are usually computed as a percent of sales. Sales are a function of price and volume. Since we are concerned only with price in this analysis, a calculation of the price change removed by hedging as a percent of cash price is a fairly accurate indicator of the extent to which net profit as a percent of sales is safeguarded.

Sizeable cash price advances and declines as a percent of the cash price occurred during the selected 8 week periods. Cash price advances and declines were larger, however, during the periods of effective hedges than during periods of ineffective hedges. In periods of effective wheat hedges, for instance, cash price advances as a percent of the cash price averaged 4.79% while declines averaged 4.72%. In periods of ineffective hedges, however, the advances averaged only 1.19% of the cash price and the declines 3.55%. In corn the figures for periods of effective hedges were advances of 6.18% and declines of 4.98%, and in periods of ineffective hedges, advances of 1.34% and declines of 2.66%. In oats, advances of 8.67% and declines of 9.12% in periods of effective hedges, and advances of 1.55% and declines of 5.96% in periods of ineffective hedges were calculated.

It was also ascertained that in periods of large cash price increases or declines, hedges serve to reduce the magnitude of the gains or losses, while in periods of smaller price change, hedges actually increase gains and losses. *Thus hedges are more effective when it is more imperative for them to be so—that is, in periods of large cash price changes, while ineffective hedges occur more frequently when the danger of losses (or gains) is less.*

Country elevators realized a net margin of profit of 1.33% of sales, on specified small grains, during the year 1939.[16] During the selected 8 week periods under study, wheat price declines of 2.51% of the cash price at the time of purchase were not removed by effective hedges. In corn and oats the figures were 2.63% and 5.78% respectively. Thus the declines not removed by hedging were over twice the 1939 margin of profit.

Price change not removed by hedging as a percent of cash price averaged 2.75% for wheat, 3.33% for corn, and 4.20% for oats. In all cases this was greater than the change removed by hedging. In addition to this 15% of the wheat, corn and oats hedges resulted in losses of 5.81%, 5.53% and 10.43% respectively as a percent of cash price. Unless the profit per dollar of sales has increased considerably since 1939, the net profit will frequently be unable to absorb the losses associated with hedged transactions. On the basis of the study it appears that hedging does not do a particularly good job of safeguarding the net margin of profit.

---

[16] Donald R. Stokes, *Marketing Margins and Costs for Grains, Grain Products, and Dry Edible Beans,* USDA, Technical Bulletin No. 934 (August, 1947), pp. 12–13.

Hedging Effectiveness and the Cash-Futures Price Spread

Because of irregular variations in the spreads between cash and futures prices, hedges were not particularly effective in reducing the risks associated with price changes during the 1949-51 period. It is interesting to note, however, that in 1951, a year of increased activity and speculation on the Board of Trade, but of limited Commodity Credit Corporation purchases, hedging effectiveness was generally greater than in 1949, a year of substantial price support activity.

Traders have generally insisted that price support activity makes it difficult for them to formulate judgments on future supply-demand relationships. Hence, they maintain that the resulting futures-cash relationships assume an erratic pattern, and hedging effectiveness decreases. Whether this is true, and whether in fact substantial support activity was responsible for the low effectiveness in 1949 and 1950 cannot be determined in this paper. It is sufficient to state that erratic fluctuations in cash-futures price spreads did occur, and consequently hedges did not greatly reduce the risks resulting from price change.

If it were possible to determine when erratic fluctuations in spreads were to occur, then it would also be possible to determine when to hedge, and when not to hedge. Thus the effectiveness of the hedges which were consumated, could be increased considerably. One possibility of predicting these erratic fluctuations in cash futures spreads, is to examine the cash-futures price spread at the time of the hedge. The relationship of this cash-futures price spread at the time of the hedge, and the subsequent effectiveness of hedge, is examined below.

In a perfect market, futures prices theoretically should be above cash prices by an amount equal to the cost of storage to the delivery month. In this type of situation, hedges are usually fairly effective, since futures price change is restricted to an area between the cash price, and the cash price plus storage costs to the delivery month. When a negative basis[17] situation occurs, however, the effectiveness of the hedge is commonly believed to decrease. When futures prices are below cash prices, long basis hedgers are faced with the possibility of paying more for the futures than they sold them for. This is true because cash and futures prices must of necessity be equal or approximately equal at delivery date. For this reason, futures prices move upward toward cash prices as delivery date approaches, and long basis hedgers are faced with losses, or at best hedges of low effectiveness. If it were not for this tendency of futures prices to move upward toward cash prices, and also for wider fluctuations in futures prices when a negative basis situation exists, the effectiveness of

[17] Basis refers to the spread between cash and futures prices. Positive basis refers to situations where futures prices are higher than cash prices, while negative basis situations prevail when futures prices are lower than cash prices.

the hedge would not be particularly different under either positive or negative basis situation. With these tendencies inherent in the negative basis situation, however, the effectiveness of the hedge decreases.

Frequency of Positive and Negative Basis Situations

The prevalence of negative basis situations during the period studied is indicated in Table 4. In wheat, for instance, a negative basis situation occurred around 50% of the time during 1949 and 1950, and 25% of the time during 1951. In corn the figures were 73%, 92%, and 54%, and in oats 96%, 96%, and 98%. More significant, perhaps, is the fact that with the exception of wheat in 1951, the average basis for all grains was negative and substantially so.

TABLE 4. POSITIVE BASIS, NEGATIVE BASIS, AND AVERAGE BASIS PER BUSHEL AT CHICAGO, 1949–51

Year	Positive Basis		Negative Basis		Average Basis[a]
	Number	Average Positive Basis	Number	Average Negative Basis	
		Cents		*Cents*	*Cents*
			Wheat		
1949	26	4.50	25	20.10	−7.41
1950	26	5.07	25	12.02	−3.24
1951	39	1.16	10	2.26	+0.44
			Corn		
1949	13	3.53	38	8.03	−4.99
1950	4	0.97	48	4.22	−3.82
1951	23	2.87	28	5.12	−1.49
			Oats		
1949	1	2.00	50	6.26	−5.98
1950	1	0.25	51	7.34	−7.19
1951	1	0.25	51	4.86	−4.76

[a] There were 52 "Basis" situations each year. Positive and negative basis situations did not always total 52 because at times the cash and futures prices were identical.

Gains or Losses on Hedges Associated with Various Magnitudes of Positive and Negative Basis

The gains or losses[18] associated with hedges initiated at different magnitudes of positive and negative basis are presented in Table 5. On hedges

[18] For instance, if at the time the hedge was initiated, cash grain was purchased at $2.00 and futures sold at $2.10, while at the time the hedge was closed out, cash sold for $1.95 and futures were purchased at $2.00, the gain on the hedge would have been 5¢ a bushel. If futures had been purchased at $2.10 a loss of 5¢ would have been incurred.

TABLE 5. PROFITS OR LOSSES IN CENTS PER BUSHEL ON 8 WEEK HEDGES, ASSOCIATED WITH VARIOUS POSITIVE AND NEGATIVE BASIS SITUATIONS AT CHICAGO, 1949–51[a]

Basis	Average Profit or Loss on Hedges, 1949–51		
	Corn	*Wheat*	*Oats*
−20.00 and below	−9.62[b]	−25.36[b]	−19.06[b]
−10.00 to −19.99	−9.11[b]	− 7.22[b]	− 5.57[b]
− 5.00 to − 9.99	−4.57[b]	− 0.82[b]	− 0.97[b]
− 2.50 to − 4.99	−1.50[b]	− 0.58[b]	− 0.26[b]
− 0.01 to − 2.49	0.94	− 0.50[b]	1.42
0.00 to + 2.49	1.92	1.88	2.93
+ 2.50 to + 4.99	5.34	2.66	—
+ 5.00 to + 9.99	9.32	4.08	—
+10.00 and above	—	9.32	—

[a] Long basis position assumed, i.e., buying cash and selling futures.
[b] Losses to long basis hedgers.

of 100% effectiveness there would be no gains or losses. On hedges during the 8 week periods studied however, wheat losses reached 27.19¢ in 1949, while gains of 11.31¢ a bushel were recorded for corn. On the average, all but one negative basis situation resulted in losses, while all of the positive basis situations resulted in gains to the long basis wheat hedger. In corn and oats the results were much the same, except that negative basis situations of from 0.01¢ to −2.49¢ a bushel resulted in small gains to hedgers.

As an average for the three years, losses in all grains increased as the magnitude of the negative basis increased, and similarly, gains increased as the magnitude of the positive basis increased. For example, wheat losses ranged from −50¢ a bushel with negative situations of −.01¢ to −2.49¢ to losses of 25.36¢ a bushel with negative basis situations of −20.00¢ and below. Gains ranged from 1.88¢ a bushel with a positive

TABLE 6. THE RELATIONSHIPS BETWEEN POSITIVE AND NEGATIVE BASIS SITUATIONS AT THE TIME THE HEDGE WAS INITIATED, AND THE EFFECTIVENESS OF THE HEDGES AT CHICAGO, 1949–51

Basis (cents per bushel)	Hedging Effectiveness		
	Wheat	*Corn*	*Oats*
−20.00 and below	− 9.37[a]	− 3.80[a]	—
−10.00 to −19.99	−18.97[a]	−128.55[a]	10.86
− 5.00 to − 9.99	15.63	− 61.73[a]	33.96
− 2.50 to − 4.99	83.91	55.17	57.34
− 0.01 to − 2.49	73.33	70.87	70.47
0.00 to + 2.49	37.86	51.49	21.21
+ 2.50 to + 4.99	46.18	25.78	—
+ 5.00 to + 9.99	45.25	− 35.45[a]	—
+10.00 and above	48.25	—	—
Average effectiveness with positive basis	51.29	26.51	21.21
Average effectiveness with negative basis	15.32	25.66	41.38

[a] Ineffective hedges are hedges which resulted in an increase rather than a decrease in gains or losses.

basis of 0 to 2.49¢ to 9.32¢ with a positive basis of 10.00¢ and above. The situation in corn and oats was quite similar. It appears that hedges which are initiated at the time of either a small negative or positive carrying charge are associated with limited gains or losses. As the magnitude of the basis increases, so do gains and losses.

Effectiveness of Hedges Associated with Various Magnitudes of Positive or Negative Basis

Data in Table 6 indicates that hedges were far more effective, when initiated in small rather than large positive or negative basis situations. In wheat for instance, hedges were actually ineffective (increased gains or losses) when negative basis situations of over 10¢ prevailed at the time of the hedge. The situation in corn was even more pronounced, while in oats hedges were only 10% effective with a negative basis situation of 10¢. On the other hand wheat hedges were 63%, corn 59%, and oats 49% effective, when future prices were within 2.5¢ of cash prices (either above or below) at the time the hedge was made. As indicated earlier, the average effectiveness of hedges was only 36% for wheat, 27% for corn, and 41% for oats. It is apparent, therefore, that if hedging is to accomplish its function of reducing risks associated with price fluctuations, they must be initiated when futures prices are either a few cents above or a few cents below cash prices. On the basis of this study it appears that very little is gained by hedging when the futures prices are more than 5.0¢ above or below the cash prices.

Conclusions

The protective feature of futures trading is based on the assumption that trends in cash and futures prices will be similar enough, so that losses on cash purchases can be offset by gains on the futures transactions. This study indicates that the need for protection is very pressing. For instance, price declines in wheat, corn, and oats at Chicago occurred almost 40% of the time over eight week periods during the years 1949-51, and averaged over seven cents a bushel. The average net margins of profit to country elevators for these three grains was under one cent per bushel during 1939, and although this margin has undoubtedly increased since then, losses of seven cents a bushel could not be absorbed for long.

Unfortunately, however, hedging does not provide complete protection to the individual trader. Although at times hedges are very effective, at other times they are not. For instance, wheat hedges in 1949 and corn hedges in 1951 were only about 9% effective. The average effectiveness for the three grains during the 1949-51 period was around 35%. Phenomenally low hedging effectiveness in 1949 contributed substantially to the low over-all average for the three year period. With the exception of corn, hedging effectiveness increased as price support activity decreased. Spe-

cifically, hedges were two and one-half times more effective in 1951, a year of limited price support activity, than they were in 1949, a year of extensive purchases by the Commodity Credit Corporation. Hedging effectiveness was, however, not particularly high even in 1951, averaging only 43% for the three grains.

This study also reveals that on the average, long basis hedgers lost almost three cents a bushel more by hedging than if they had not hedged. Around 20% of the hedges resulted in losses of five cents or more per bushel. A certain part of the loss is attributable to a rising price level. However, since price increases occurred only about 60% of the time, upward price trends are only partially responsible for these losses. More important is the fact that (a) the magnitude of the cash price increases were greater than the declines, and (b) cash price declines and futures price increases occurred more frequently than futures price declines and cash price increases. These types of situations make it exceedingly unattractive for long basis hedgers.

Cash price change, as a percent of the cash price, averaged 5.2% during the period studied. Price change removed by hedging as a percent of cash price was only 1.8% thus leaving 3.4% of the change unremoved by hedging. The severity of this situation is qualified somewhat when the effectiveness of hedges is studied during different periods of time. When this is done, it is found that hedges are *most effective in periods of large cash price change*. It is only during periods of small cash price change that ineffective hedges predominate, a period during which risks are of course relatively low, and hedging is less necessary as a protective device.

This study also reveals that for the three grains studied, negative basis situations occurred around 70% of the time during the 1949-51 period, and averaged almost 4¼¢ a bushel. On the average, large negative basis situations resulted in large losses and little protection for the long basis hedgers. For wheat, losses during the 1949-51 period averaged 25.36¢ a bushel when the futures prices were 20¢ or more below the cash prices at the time of the hedge. On the other hand, gains of 1.88¢ a bushel occurred when futures prices were either equal or not more than 2½¢ a bushel above the cash price at the time of the hedge. In corn the losses averaged 9.6¢ and the gains 1.92¢, and in oats the losses were 19.06¢ and the gains 2.93¢ in these negative and positive basis situations. The effectiveness of hedges was also directly correlated with the magnitude of positive and negative carrying charges at the time of the hedge. The larger the spread between the cash and futures prices, the less effective the hedge.

On the average it was advantageous to hedge in the near or 2nd near month future only when futures prices were not more than 5.0¢ above or below cash prices when the hedge was effectuated. Within these limits close to 53% of the risks associated with price change were removed. On

the other hand, when futures prices were either above or below cash prices by more than five cents, hedges became almost completely ineffective.

Risks of losses can on occasions be reduced by hedging. Hedging by no means removes all of the risk associated with cash price changes, however, and many hedges result in little or no protection.

NOTES

DETERMINING THE OPTIMUM ANNUAL RATE OF LAYING FLOCK REPLACEMENT*

FOR several years, many poultry scientists have recommended a 100 per cent annual rate of laying flock replacement, or an all pullet flock. This recommendation was based upon experiments comparing unculled all pullet and all hen flocks in respect to (1) average quantity of eggs produced annually, (2) distribution of egg production within the year, and (3) mortality. Pullets produced 20-25 per cent more eggs than hens. Also, pullets produced more eggs than hens in the periods of highest egg prices. In most of these experiments, mortality was higher for hens.

Agricultural economists also have recommended all pullet flocks. The economists recommendations have been based upon survey records of poultry flocks.[1] Higher net returns were obtained for poultry enterprises with all pullet flocks. Cross tabulation of survey records was the method of analysis. Difference in managerial practices or basic production ability of the birds were not taken into account in these analyses.

The poultryman has the alternative of replacing his flock at any rate between the rate of mortality and 100 per cent. In order to decide on a rate of annual replacement, he needs to know the nature of the relationship between net returns per bird and the proportion of pullets in the flock. He needs this information for different price-cost situations, kind and productive ability of birds and his production practices.

The purpose of this paper is to outline the principles for determining the optimum annual rate of laying flock replacement. These principles provide a basis for appraising the "all pullet flock" recommendation by poultry scientists and agricultural economists. The annual rate of laying flock replacement depends upon:

(1) The number of low producing birds culled within the preceding year, which in turn, depends upon (a) the price of eggs, (b) the price of feed, (c) feed consumption per bird, and (d) the egg production distribution of the individual birds in the flock;

---

* John Krchnavi, graduate student at Oregon State College, assisted in the preliminary work on this problem.

[1] cf. Kearl, C. D. Commercial Poultry-Farm Management in New York State, 1946-47. Cornell University Agricultural Experiment Station Bulletin 864. 1950. pp. 20-21; and, Nodland, T. R., Haley, F. T. and Pond, G. A. Costs and Returns from Poultry, 1947-50. Mimeo Rep. No. 194, Division of Agricultural Economics, University of Minnesota, 1952, p. 10.

(2) The cost of replacing each bird in the flock; and
(3) The rate of mortality, and differences in mortality between pullets and hens.

Assumptions

The major assumptions for the analysis to follow are:
(1) The average annual unit price of eggs from pullets and hen flocks is the same;
(2) The annual mortality rate is the same for pullets and hen flocks;
(3) Hens consume 5 per cent less feed than pullets for the same annual production of eggs;
(4) Annual production declines by 20 per cent each year as the age of the hen increases;
(5) The replacement cost per bird is the same regardless of the number or proportion of the flock replaced; and
(6) Pullets grown for flock replacement have the same basic productive ability as the hens.

These assumptions are based in part upon experimental evidence and in part upon the lack of evidence to the contrary. Many poultry scientists may be unwilling to accept assumptions (1) and (2).

The higher proportion of pullet production in the top portion of the egg price cycle has been advanced as an argument for ascribing higher egg prices to pullets. But this fails to take into account the number of "pee-wee" to medium sized eggs produced in late summer and early fall by pullets, the time of highest egg prices in past years. This peak period in prices has been shifting toward mid and early summer, which reduces or eliminates any advantage to pullets on late summer and early fall production. Since price discounts usually are made for small eggs, it may be more realistic to assume a higher average annual price for hen eggs. However, we assume the same unit price for hen and pullet eggs.

Another major argument advanced to favor the all pullet flock is the higher mortality in hen than pullet flocks. Experimental and survey evidence on this point is inconclusive. Such evidence as obtained was based upon pullet and hen flocks under average management.[2] Under "average" management, any disease in a flock perpetuates with time when birds are carried over from one year to the next. This contributes toward higher mortality for mixed or hen flocks than for all pullet flocks. Perhaps poultrymen could more easily effect disease preventive measures with an all pullet than with mixed or all hen flocks. The transition period from one flock to another provides an opportunity to clean and disinfect the laying quarters. This advantage of pullet flocks can be reduced by adapting the facilities and disease preventive measures to the practice of carrying over

[2] An effort was made in the experiments to approximate average farm conditions with respect to the application of disease preventive measures and culling practices. We could expect different results on mortality for the better than average farm flock managers or commercial poultrymen.

birds from one year to the next. Additional costs may be incurred in adopting these practices. If there is a difference in mortality between hens and pullets under good management, it probably would not be large enough to alter significantly the conclusions from this analysis.

Differences in feed consumption for pullets and hens with the same annual production of eggs occur because of the additional feed requirements of pullets for growth. This difference in feed consumption has been estimated to be 10 per cent. We choose a more conservative 5 per cent figure for use in working through an example on the optimum annual replacement rate.

The production decline per bird of 20 per cent annually is based upon experimental evidence. The 20 per cent figure may not fit all flocks, but it is about an average among the experimental results reviewed. This is based upon unculled flocks.

The net replacement cost per bird is the cost of growing pullets to the egg laying stage, less the market value of the bird for meat. The major cost items of replacing birds in a flock are (1) initial cost of chicks, (2) feed inputs for the growing pullets, (3) building and brooding facilities, and (4) labor. These costs are approximately the same per bird regardless of the number of pullets produced. Initial costs and feed inputs per bird are fixed costs. Some economies to scale could exist for buildings, brooding facilities and labor. However, these items make up only about 20 per cent of the total cost of producing pullets. Within the range of numbers of birds relevant to this analysis, we would expect little if any variation in labor and building costs. Under current prices, the total investment in each bird of a culled leghorn pullet flock will average about \$2.50.[3] A lower investment (\$2) also will be used in the analysis to demonstrate the effect of varying levels of replacement cost upon the optimum annual replacement rate. A market value for meat of \$.70 per bird is deducted from these gross investment figures to obtain net replacement costs per bird.

Rate of Culling Within a Production Period

For any given flock, a poultryman will maximize profits (or minimize losses) in a year by retaining only those birds that return an income above

---

[3] This cost figure is based upon the following:

Twenty-six pounds of feed @ 5¢ per pound	\$1.30
Initial cost of bird (sexed)	.36
.2 hr. labor @ \$1 per hour	.20
Cost in mortality per bird raised	.10
Housing, litter, brooding, etc., per bird	.24
Loss on cull birds, allocated to remaining birds	.30
Total per bird	\$2.50

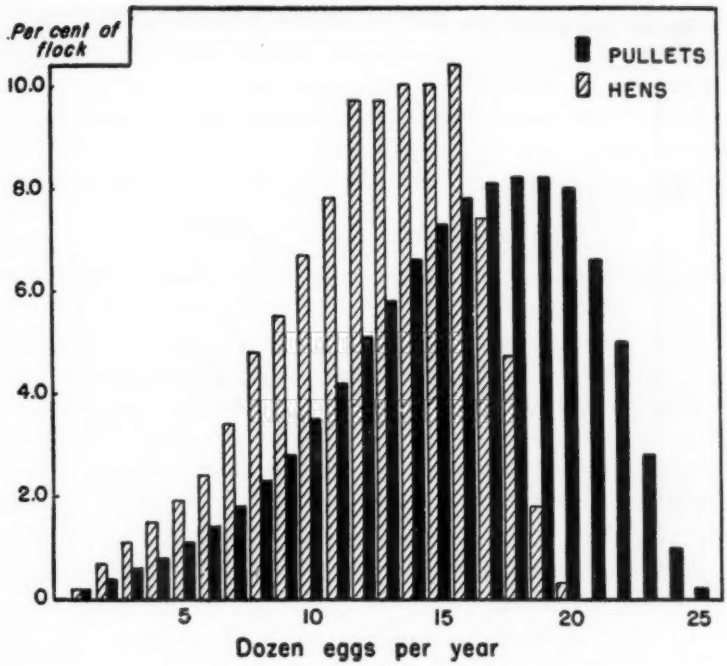


FIG. 1

variable costs. Feed is the major variable cost item in egg production. Although labor and some other input items may vary with the number of birds culled, the amount of variability in these items with flock size is too small to make a significant difference in the best culling rate. Feed will be considered the only variable cost in a production period (year). Maximum returns above feed cost will occur when birds below the "break even" point on value of eggs and cost of feed are removed from the flock. Birds are below the "break even" point when the value of eggs they produce is less than the value of the feed they consume. The information needed for determining the rate to cull are the production of the individual birds in the flock, feed requirements, and prices of feed and eggs.

Application of the culling principle can be demonstrated by use of an egg production distribution by birds in an ROP leghorn pullet flock, specific prices for eggs and feed, and the feed requirements for birds with different annual rates of production. The solid bars in Fig. 1 represent the egg production distribution for birds in the unculled pullet flock. The other bars in Fig. 1 are the estimated production of birds of the same flock carried over into the second year without being culled as pullets. These production percentages were derived by discounting the production of each pullet by 20 per cent.

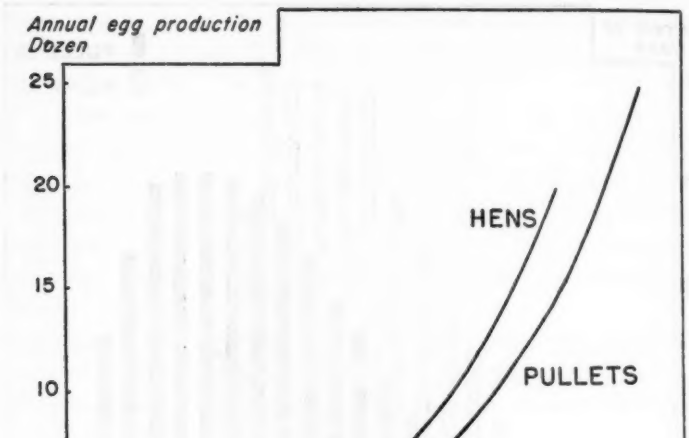


FIG. 2

Higher producing birds within a flock will consume more feed per bird than will the low producers. However, the higher producing birds will consume less feed per dozen eggs than will the low producing birds. The curves in Fig. 2 express this relationship. The relationships expressed in Fig. 2 do not refer to input-output curves for a single pullet or hen, or birds of the same productive ability. The feed requirements estimated for pullets at different annual rates of production are based upon various estimates of poultry scientists and upon a survey of egg production costs in Oregon.[4] The feed consumption curve for hens is the estimated feed requirements of pullets discounted by 5 percent at each production level.

The next step is to value the egg production and feed consumption for each bird in the flock to find the break-even point on feed costs and value of eggs. If the price of eggs were 50¢ per dozen and the price of feed $5 per cwt., this break-even point would occur at about 10 dozen eggs for both pullets and hens.[5] That is, with these assumed prices of feed and eggs, about 10 dozen eggs annually are required to pay for the feed a leghorn bird producing at this rate will consume in a year. About 15 per

[4] M. H. Becker. Unpublished data of the Oregon Agricultural Experiment Station.

[5] This break-even point would occur at a lower level of production for hens when computed for a continuous egg production distribution instead of discrete because of the lower feed requirements for hens.

cent of the pullets would be culled on this basis. Another 13 per cent of the original pullet flock would be culls the second year, making a total of 28 per cent of the birds culled for low production over a two-year period. The culling rate should be decreased when the price of eggs is high relative to the price of feed. Conversely, the culling rate should be increased when the price of feed is high relative to the price of eggs.

Optimum Annual Replacement Rate

Annual replacement is necessary to replace cull birds and birds lost by mortality if a given sized flock is to be maintained over time. Application of the culling principle appears to be inconsistent with 100 per cent annual rate of flock replacement. About 70 per cent of the birds carried over into the second year (excluding mortality) make a return above feed costs. The question arises, do some of the costs considered fixed for one year become variable and modify the culling principle when determining the optimum annual replacement rate? There is one major item to add to the variable cost column—the replacement cost per bird.

The optimum annual replacement rate will be determined inductively. The production distributions in Figure 1, feed requirements in Figure 2, and prices of feed and eggs as assumed above provide a basis for computing functional relationship between the average returns per bird above feed and replacement costs and annual replacement rate. The net returns per bird computed are a maximum under the price and production conditions assumed. These maximum returns are not intended to be realistic in the sense that poultrymen can expect these same returns. However, the nature of this relationship is realistic. The effects of mistakes in culling and mortality are taken into account following the determination of this net returns function.

Returns above variable costs

We compute first the average return per bird above feed cost. The average return per bird above feed cost for the culled pullet flock was $2.28. A flock of the same size consisting of the top 10 per cent of the hen flock in production combined with 90 per cent culled pullets gave an average return per bird above feed cost of $2.38. By increasing the proportion of hens and decreasing the proportion of pullets in this manner, a relationship between annual replacement rate and average returns per bird above feed cost was established. This relationship appears as the top curve (curve C) in Figure 3.

Next, the relationship between annual replacement rate and replacement cost per bird was determined. Since we already have assumed this relationship to be linear, it is only a problem of locating it in Figure 3. At the 100 per cent annual replacement rate this cost (as assumed) is

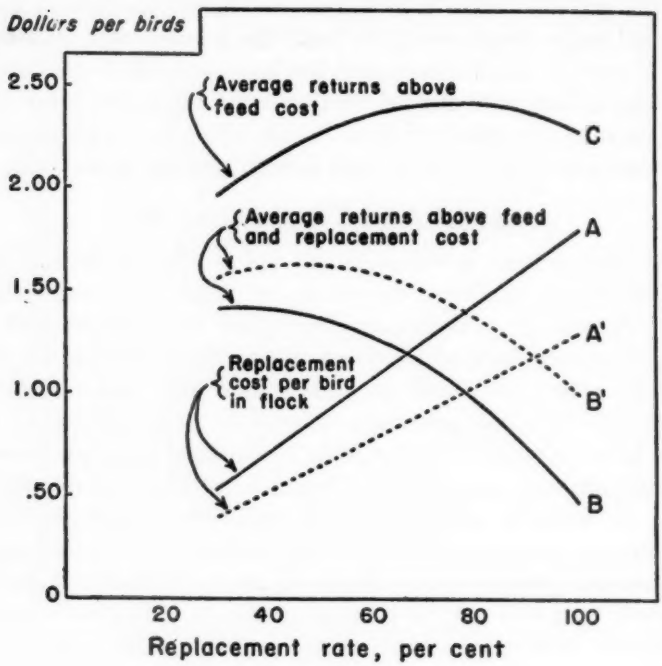


FIG. 3

$1.80 per bird in the flock ($2.50 minus $.70 market value of the bird). At 90 per cent replacement rate, this cost is $1.62 per bird (90 per cent of $1.80). By computing all these net replacement costs to a 30 per cent replacement rate, we have a linear function increasing from $.54 to $1.80 per bird in the flock (Cure A in Figure 3).

The difference between curves A and C in Figure 3 is the net returns per bird above feed and replacement costs. This relationship is plotted as curve B in Figure 3. The computed relationship between average returns per bird above feed and replacement cost and the replacement rate shows a maximum return per bird at about the 30-40 per cent replacement rate. There is little decline in the net returns per bird until the replacement rate becomes higher than 50 per cent. From 30 to 50 per cent annual replacement, the net income per bird is about $.90 higher than the net income per bird at the 100 per cent annual replacement rate. The curves are not extended below the 30 per cent replacement rate since about this amount is required to replace cull birds of the hen flock. More than 30 per cent replacement rate may be required to replace cull birds in case of flocks made up of some birds over two years of age. Our analysis is based primarily on one and two year old birds.

Curves A′ and B′ in Figure 3 are based upon a gross replacement cost

per bird of $2. The optimum replacement rate is about 50 per cent annually under this replacement cost. This is a higher replacement rate than obtained for Curve B. Also, the maximum difference in net returns per bird in the replacement rate interval of 30 to 100 per cent is less than in the case of the higher replacement cost ($.50 compared with about $.90). Therefore, a lower replacement cost per bird will have the effect of (1) increasing returns per bird in the flock, (2) increasing the optimum annual replacement rate and (3) decreasing the range in net returns above feed and replacement cost for varying proportions of pullets in the flock. A horizontal replacement cost function, or zero net replacement cost, would move the optimum replacement rate to the maximum average returns above feed cost. This would occur at about the 75 per cent annual replacement rate. The lower limit of the optimum annual replacement rate would be the replacement of cull birds and birds lost through mortality, or 30-40 per cent.

Practical Considerations in Annual Flock Replacement

Objections to the preceding analysis may be raised on the grounds that (1) all aspects of mortality were not taken into account, (2) no poultry man could cull birds as assumed for these computations, and (3) only pullets and two year old hens were considered.

The occurrence of mortality would lower the net returns per bird at each replacement rate. Mortality would not change the general shape of the relationship unless a difference in mortality rate between hens and pullets existed. We have assumed these mortality rates to be the same. Mortality has an effect in addition to decreasing returns per bird. The size of the flock was not a consideration in the preceding analysis. To maintain a flock at a given size from year to year, the replacement rate determined above will have to be increased by the size of the mortality rate.

A practical culling problem does exist for the poultryman. He has the problem of estimating the price of eggs, price of feed, and production of his birds for a year or more in the future in order to decide how many replacements to produce. The returns above feed and replacement costs computed and plotted in Figure 3 indicates considerable flexibility exists in the annual replacement rate. That is, net returns per bird will vary but little from the maximum over a wide range of replacement rates. This flexibility is greater for the lower replacement cost per bird. A margin per bird of about $.90 (curve B) or $.50 (curve B′) for the 30-60 per cent annual replacement rates over the all pullet flocks provide margins too large to be dissipated by mistakes in culling. When culling by the poultryman produces results no better than could be expected by removing from the flock a random sample of birds, these margins could be eliminated. In

this situation, a linear relationship between net returns per bird and the annual replacement rate could exist.[6] If a linear relationship did exist, the poultryman would have 3 alternatives: (1) he could replace birds at the mortality rate, (2) he could withdraw from the business, or (3) he could choose an all pullet flock. Under the condition of high replacement cost per bird, the poultryman may choose to replace birds at the mortality rate or withdraw from the egg production business. When replacement costs are low, he may choose an all pullet flock. With the application of some culling ability, his net returns per bird possibilities for different replacement rates take the form of the relationships shown in Figure 3 (curves B and/or B′). The better poultry managers will come closer to the computed maximum average returns per bird than will the poorer managers.

The preceding analysis was based upon birds one and two years of age. About half of the original flock would return an income above feed cost in the third year of production (assuming a 20 per cent reduction in production from the second to the third year). A new distribution of hen production (two and three year old birds) would differ with the production distribution of two year old birds. A smaller proportion of birds in the new distribution would produce at the annual rate of 15-20 dozen eggs. This will have the effect of (1) decreasing the income margin of "mixed" flocks over all pullet flocks and (2) increasing the optimum annual replacement rate.

Conclusions

The increased demand for baby chicks as poultrymen have shifted toward all pullet flocks has been accompanied by an increase in hatchery facilities, increase in number of farmers producing eggs for hatcheries, and an increase in facilities for growing pullets on the farms. It is possible that these production adjustments have been decreasing the efficiency of resource use in the poultry industry. Increased broiler production has been a big factor in the past increased demand for baby chicks. However, sizeable reductions in the production of baby chicks may be effected by a reduction in the annual replacement rates of laying flocks by poultrymen.

---

[6] The lack of culling ability of farmers is implied by poultry scientists in their all pullet flock recommendation. The accounting procedure used as a basis for recommending an all pullet flock can be demonstrated by use of the hen and pullet flocks of Figure 1 and the prices as assumed for this analysis.

	All hens	*All pullets*
Average total returns per bird less feed costs (unculled flocks)	$ .98	$2.07
Net replacement cost (prorated over two years for hens	.90	1.80
Net above feed and replacement cost (per bird)	$ .08	$ .27

The preceding analysis suggests the need for a reconsideration of the all pullet flock recommendation by poultry scientists and others. An annual replacement rate of less than 100 per cent, combined with (1) an improvement in culling practices and (2) effective disease preventive measures appears to be the bases for greater efficiency in egg production.

W. B. BACK AND M. H. BECKER

Oregon State College

PROGRAM ANALYSIS IN WATER AND LAND MANAGEMENT AGENCIES*

At various stages of project formulation, the program, project, or segment of a project under consideration must satisfy the criterion that it would be more economical than any other actual or potential available means, public or private, of accomplishing the specific purposes involved. . . .

The alternate possibilities to be considered in applying this limitation should include all practicable means of accomplishing the desired results which are within the purview of the agency making the economic analysis. . . .[1]

SINCE the availability of economic resources is limited, the best program uses the least of these resources to attain the desired objectives. Many of the objectives are very subtle in nature, and the act of placing a monetary value on them is frequently considered sacrilegious. Such charges misinterpret the value of the economics approach. The economic criterion is not a value in itself, but rather a tool, helpful in maximizing value fulfillment.[2] Any set of goals, regardless of subtlety, involves a change in availability of resources. Economics seeks to quantify these relationships and place comparisons between competing goals on a systematic and direct basis so that where a choice between alternate proposals must be made it can be made rationally.

This problem of choice is ever present. Our real world is limited so that it is impossible to have maximum education, medical care, resource conservation, etc., all at the same time. The choice can be made by many methods and today often is resolved by cloak room compromise. A more consciously rational approach tries to place the comparison of elusive values on a direct basis. This comparison is a fundamental procedure

* The author wishes to acknowledge the suggestions of J. Margolis of Stanford University, E. C. Banfield of the University of Chicago, and P. Dickinsen and V. J. Hansen of the Bureau of Reclamation. The views are naturally those of the author alone, and are in no way official views or findings of the Bureau of Reclamation.

[1] Subcommittee on Benefits and Costs, *Proposed Practises for Economic Analysis of River Basin Projects*, Report to the Federal Inter-Agency River Basin Committee, Government Printing Office, Washington, 1950, page 37.

[2] Frank H. Knight, *Freedom and Reform*, Harper & Bros., New York, 1947, Chap. X.

implicit in the economic criterion, so inclusion of the quoted recommendations in the policy directives to the water and land management agencies concerned[3] ought to assure maximum efficiency in the development of river basins. But practical limitations seriously reduce the effectiveness of these principles. Recognition of the nature of such limitations is necessary for a reformulation of public policy resulting in better resource utilization.

Careful interpretation of the initial quotation suggests two major limitations. One limit concerns the problem of general comparison. Its abstractness has permitted applications of resource analysis which lack the rigor necessary to validate the implied comparisons. The need to compare all alternate programs is stressed, though such a task would be astronomical if use was not made of traditional evaluations of resources. The prices for the use of resources measures the approximate value[4] which society places on the goods or services made available by each resource.[5] Hence, comparison of the benefits of each program with the costs, which is standard procedure now, theoretically implies a comparison of the benefits of each program with the benefits resulting from the different competing uses of the resources required by the particular program.

If this implicit comparison is to have practical meaning, prices must be chosen carefully, so that they actually reflect the productivity of the resources in alternate uses. Unfortunately this requirement is not always satisfied by procedures of the water and land management agencies. The Bureau of Reclamation, for example, uses an interest rate of 2.5 per cent to calculate the cost of money for multi-purpose projects, when money employed for private power is productive enough to return about 5 per cent after taxes. Note that 2.5 per cent is the cost, not the productivity of the money. Furthermore, the economic life of public projects is sometimes calculated to be as high as 100 years, while investments in private enterprises are restricted to activities sufficiently productive to recover capital in less than 25 years.

To add further meaning to the prices used, it is necessary to correct for their approximation of real social values. Currently, this correction is made by means of indirect and intangible benefits and costs, items

---

[3] Dep't of Interior, Bureau of Reclamation, *Manual*, Vol. III, Chap. 3.1, Par. 5L, Release #20, Sept. 13, 1950, which reads, "The selected multiple-purpose units or projects should be more economical of development as a whole than other potential means for accomplishing the same aggregate benefits."

[4] The accuracy of the approximation depends on the degree of perfection of the market.

[5] F. H. Knight, *Risk, Uncertainty and Profit*, Chap. 3. *See also* Subcommittee on Benefits and Costs, *Op. cit.*, pages 6-7.

which include most of the difference between market values (price) and social values. Indirect benefits have been defined as:

> . . . effects arising as a consequence of the direct benefits, and include increases in production of goods and services over and above those classified as direct benefits.
>
> . . . (Indirect costs) arise in connection with the indirect benefits, and include costs to producers, processors, or traders required in conjunction with the physical flow output of the proposed project.[6]

> Intangible benefits are those which are not susceptible of evaluation in monetary terms but which, nevertheless, are real and in some instances of commanding importance. . . . Examples of intangible benefits are: (1) provision of new economic opportunities, (2) added national security, (3) improved national diet, (4) stabilization of community incomes, and (5) improved community welfare, through additional settlement. . . .[7]

Some indirect and intangible effects may not be produced by alternate private projects, e.g., stabilization of community income. Other effects are associated with alternate private projects: new investments generally provide for new economic opportunities. Moreover, many private projects have other types of indirect and intangible effects. In a fully employed economy, the total rate of investment is limited and actions increasing the rate of investment in one sector result in counterbalancing reductions elsewhere. Therefore, in addition to the productivity represented by the market costs of a particular project, there are costs which represent the indirect or intangible effects associated with some other project which is sacrificed because of the addition of the project under consideration. However, there is no indication in the report of the Subcommittee on Costs and Benefits[8] or in the *Manual* that any attempt is made to include factors accounting for the indirect and intangible effects which are sacrificed. In contrast, these effects associated with the project have been considered. It has been suggested that the marginal activities replaced by public projects have no secondary benefits.[9] Such an assumption is actually arbitrary because there is both favorable and unfavorable evidence still unweighed by any disinterested authority. This involves a serious defect since the effects disregarded are of considerable proportion.[10]

---

[6] *Manual*, Vol. XIII, Chap. 1.4, Par. 1, Release #1, June 23, 1947.

[7] *Manual*, Vol. XIII, Chap. 2.2, Par. 4, Release #1, June 23, 1947.

[8] *Revised Statement on Secondary Benefits*, Subcommittee on Benefits and Costs, Federal Inter-Agency River Basin Committee, Unpublished, January 8, 1952. The majority report recognizes that secondary benefits are associated with all productive projects. However, the appended *Interior Minority Statement on Secondary Benefits*, disputes this point and I don't know if the argument has been settled yet.

[9] *Interior Minority Statement on Secondary Benefits.*

[10] A closely related conclusion regarding the multiplier effects of government spending has been presented in a series of articles entitled, "Multiplier Effects of a

To improve methods of analysis, the comparative evaluation must be consistent throughout. Either the sacrificed indirect and intangible effects must be calculated (something which seems impossible because the particular project displaced by the one under consideration is unidentified and no market exists to provide estimates of the effect), or some rigorous estimate must be made of the usual relative value between the direct, indirect, and intangible effects of the competing programs.

In addition to the inaccuracies due to the use of market prices to help estimate the general value of alternate activities, there is the problem associated with consideration of particular alternate projects which have similar objectives. This problem is due to the nature of the second limit on smooth application of the policy directive. This obstacle is the jurisdictional restriction which reduces the range of alternatives "within the purview of the agency making the economic analysis." Theoretically, the purview includes all possible projects which will accomplish the specific set of objectives commissioned to the agency. But frequently there is a tendency to ignore projects depending in any significant measure on private enterprise. This failing is important because of the large wastes involved, so it is worth trying to expand the effective purview.

This restricted purview occurs possibly because the sentiment favoring the public enterprise which meets important social needs, indicates apparent inability of some private sector to provide for the need. It is partly due to the fact that the needs and objectives involved are frequently critical, requiring direct, positive action to relieve local anxiety and concern. But the areas in which suitable public action is legal, are limited.[11] Therefore, where there seems to be no positive method by which an interested agency can induce private action even if such action is more economical, then pressure groups will continue to favor disregard for private action.

If the relevant net indirect and intangible effects are sufficiently large

---

Balanced Budget," *Econometrica*, Vol. XIV, 1946, pp. 148-158, and Vol. XIII, 1945, pp. 311-318. The indirect effects are labelled multiplier effects, but are really identical, viz., effects occurring because of the activity of primary components of an investment program. The consensus was that the critical factor controlling the value of multiplier effects, is whether or not there is dependence between public and private spending.

[11] Naturally, convincing evidence for these practical limitations is hard to find. But there are a few positive indications. "There may be alternate possibilities which are not known to an agency responsible for project analysis." (Subcommittee on Benefits and Costs, *Proposed Practises for Economic Analysis of River Basin Projects*, page 37.) Do the unknown possibilities include private projects? I can't find any reference in the *Manual* recognizing the existence of projects not under the jurisdiction of the Bureau of Reclamation, though some evidence regarding the function of supplementing private activity may be found in Vol. III, Chap. 1.1, Par. 1, March 22, 1949, "Although Congress . . . had encouraged individual and private efforts in the direction of irrigation, there was a growing recognition of the need for federal sponsorship."

to explain the failure in the private sector, direct participation of the public in a project will continue to be a logical restriction on the range of alternatives. Since estimates of the size of these net effects as well as direct effects, is probably excessive, systematic revision is needed. Prices used in estimates must be standardized to reflect productivity more accurately. Non-direct values of private projects must not be underestimated according to arbitrary assumptions. Possible private sponsored projects accomplishing similar aims must be recognized. Provision must be made to investigate special reasons for the failure of private enterprise to meet society's needs where the private sector seems best equipped. Frequently, inadequate information is responsible. It is probably more economical to relieve such conditions than to disregard potential private action entirely. Where private action is preferable, a properly organized publicity campaign may stimulate private action to reduce the irritations at a satisfactory rate.

In general this program of revision will reduce the relative attractiveness of public investments in many areas, though the problems which first demanded public attention are not reduced proportionately. Therefore the need to devote more attention to the discovery, publicity, and initiation of solutions involving private investment and activity is an important feature of the above proposals.

Maximum economic and social progress is partly dependent on the best use of our resources. In order to improve the use of our resources it is necessary to improve the methods for the comparative evaluation of private and public investments and for the translation of desirable private and public proposals into operating projects.

CHARLES TIPLITZ

Bureau of Reclamation

THE THEORY OF THE KINKED OUTPUT PATH RESPONSE

A RECENT *Journal* article advanced the hypothesis that on both multiple and single-enterprise units the aggregate output function is perfectly elastic (or nearly so). This conclusion was in conformance with previous work by the senior author on the aggregate output function for agriculture.[1]

This paper attempts to explore the output relationships a person might expect to find under a somewhat different hypothesis. The hypothesis here advanced is that the output path response is a kinked function, the direction of the kink based upon farmers' evaluation of their relative

[1] Willard W. Cochrane and William T. Butz, "Output Responses of Farm Firms," *Journal of Farm Economics*, XXXIII, November, 1951, and Willard W. Cochrane, "Farm Price Gyrations," *Journal of Farm Economics*, XXIX, May, 1947.

prosperity.[2] The first application of the kinked hypothesis is a single commodity enterprise on single or multiple enterprise family farms under the assumptions that in a nonstatic frame of reference the productive agents are not fixed, resources may be combined in varying proportions, and resources may shift among firms or between industry and agriculture. The second application is the aggregate output of agriculture as a whole under the same assumptions.

Short Period Commodity Response

The kinked output path is a hypothetical graphic description of the manner in which the commodity output of a family farm and hence the aggregate of farms is believed to respond to price, in the usual economic context including uncertainties within which farmers operate. *It is not a supply curve in the sense of a net relationship between price and output based on the assumptions of ceteris paribus, nor is it one of the firm's cost curves nor an aggregate thereof.*

Figure 1 is a diagram of the kinked output path for a particular product. Times are "good" for the farm operator, i.e. the economy as a whole is approaching or at full employment, farm product prices generally are rising, and farm income is considered satisfactory by the entrepreneur. The element of uncertainty is that the farmer-entrepreneur does not know how long the good times will continue nor how long particular farm product price relationships will persist.

The price of p_0 represents the level of "responsible" price to which the producer responds.[3] However the realized market price may be, and at various times certainly is, different from this price. How would the farmer respond when the realized price departs from the norm?

With an increase in price this branch of the curve suggests that the output response will be inelastic. In good times the farmer may not be interested in increasing output and money income because the "leisure" component becomes relatively more important than income in the maximization of family satisfaction. Also in view of the uncertainty existing under the short time period assumption, the farmer considers the uncertain prospects of enhanced money income from expanded output not to be

---

[2] The idea of the kink was carried over from the author's seminar on the economics of the agricultural processing industries where considerable time was spent on the problems of oligopoly-oligopsony. The debt to Paul M. Sweezy and C. W. Efroymson for this application will be apparent to economists familiar with their work. My further debt to colleagues at the University of Wisconsin, especially Sydney D. Staniforth, for assistance in making this application is also large.

[3] The term "responsible" prices is taken from Cochrane and "refers to those prices which cause farmers to make the decisions they do in planning for this year's or the current year's production." Willard Cochrane, "An Analysis of Farm Price Behavior," Pennsylvania State College Progress Report No. 50, May 1951, p. 27.

worth the added expenditure of effort. Furthermore it would be difficult for him to increase output even if desired, except by intra-firm substitutions, because resources are generally fully employed throughout the economy.

With a price decrease, the kinky hypothesis suggests that the output response may be elastic. With good times the farmer receives an income which he considers satisfactory, and he is unwilling to make the effort to increase this income although such possibilities exist. However with a decrease in price a decrease in farm income is in prospect. The farmer's response is to shift resources away from the product whose price has fallen to the next best alternative use of resources. The net result for the particular product in question is a decrease in output.

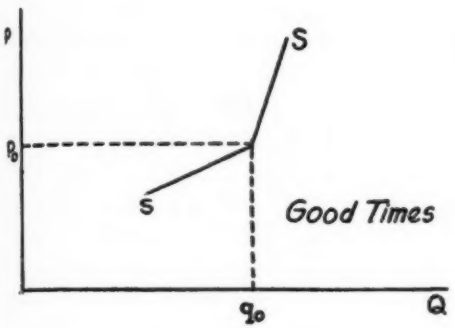


FIG. 1

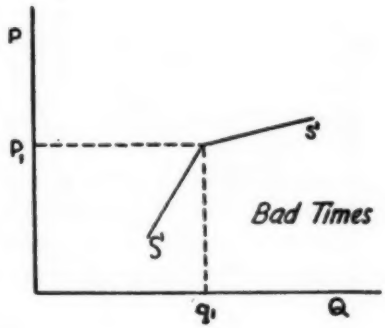


FIG. 2

Figure 2 represents the kinked output path under the same assumptions as above except that generally "bad" times are postulated. In bad times the economy is operating with a considerable amount of unemployment, farm prices generally are falling, and farm income is considered to be unsatisfactory to the entrepreneur. In the short time period here assumed the farmer is uncertain how long this particular economic context will persist. This bad times assumption accounts for the difference in the direction of the kink from that of Figure 1.

If price goes below p_1 for the commodity under consideration when times are bad, the kinked hypothesis indicates that the farmer's response would be inelastic. This can be argued for on the grounds that during bad times the individual farmer is largely stuck with his present practises and procedures although it might be more profitable to shift to alternatives. One reason for this is that uncertainty prevails regarding the persistence of present price relationships and the development of the corner round which prosperity is presumed to be. Thus the farmer's inclination with prices tumbling all about him may be to stick it out on the present line.

Another reason for not changing to new production is that it usually costs money to make the change. Most farmers don't have the necessary money, nor can they easily acquire it during depressions, to make changes.

It is likely that the inelastic response along the S^1 branch is fairly typical of the output of an agricultural commodity during bad times when all other agricultural prices are likewise falling. A less realistic branch of the curve under these conditions is s^1. If the price of a commodity increased above p_1 while other agricultural prices were falling, the response would be elastic only for those farmers who would and could make the necessary changes. Certainly incentives to a greater (more profitable) level of output exist. The farmer in these times is under considerable pressure to increase his money income. Furthermore there are available unemployed (or underemployed) resources out of which the increased output can arise.

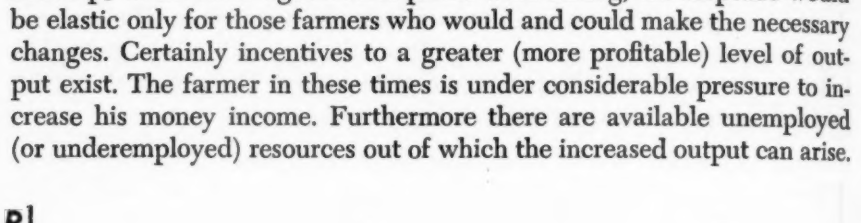


FIG. 3

The realism of the s^1 branch is enhanced if the definition of bad times is modified to a context where although low incomes and low employment still exist, there is a firming up of prices as though the lower turning point of the cycle had been passed. At this stage an elastic response to a price increase is more likely because of the fact that an improvement in product prices generally precedes changes in factor cost-prices. The entrepreneur's desire for increased income can result in increased income by expanding production greatly in the commodity whose price has risen.

When the commodity output response in both good and bad times is combined in one diagram as in Figure 3, the results are rather interesting. Inelasticity in the output response emerges in the broken inelastic function represented by SS^1. But this appears to be a special case. Under very restrictive assumptions it might be argued that with good times, all prices are rising including this one, hence the output response is inelastic. In

bad times with all prices falling including this commodity, the response is inelastic also. However in a more broadly conceived framework, the case is built for the existence of the s and s^1 branches of the output path response function.

Technology is the catch-all which determines the position of the kinked functions. With changes in technology involving the use of new production functions the output path shifts to the right. Such a shift is portrayed in Figure 3 from the position of the curves at (A) to position (B).

Up to this place the existence of the kink has been assumed and the logical consequences of its hypothetical existence have been extended into the several situations above. However some attempt can be made to reason back to the factors which might explain (or at least be consistent with) the kink.

The activity of individuals and firms is conveniently classified in economic theory as maximizing behavior. Thus the individual seeks to maximize utility subject to the constraint of income, and firms seek to maximize profit subject to the constraint imposed by the production function.[4] In the concept of the family farm in agriculture there is the mixing of the individual in the entrepreneur. Where a farm is being used as an instrument of meeting a family's needs and purposes, it is difficult to conceive of any simple variable which is being maximized. However a monolithic category may be established as a variable to be maximized if the aggregation is appropriate.

Such a variable to be maximized by the family farm entrepreneur is family satisfaction. Two other variables related to family satisfaction are leisure and net income. These variables have likewise been aggregated. Net income represents those goods and services which can be bought for money which contribute to family satisfaction. Leisure represents those elements of use and enjoyment which cannot necessarily be valued in money terms. As the individual increases his units of leisure, he decreases the units of effort supplied by him.

In Figure 4 let A and B represent leisure and net income respectively. The negatively sloping curves are iso family satisfaction curves, each curve representing equal amounts of family satisfaction with varying combinations of leisure and net income. Each successive curve to the right indicates a higher level of family satisfaction.

This set of curves expresses the relative terms in which income and leisure are valued by the farm family. It is apparent from their shape and position that during bad times (low income levels) the farm family values income highly relative to leisure. In other words the family would forego

---

[4] As elegantly expressed in J. R. Hicks, *Value and Capital*, Oxford, 1939, Appendix to Chapter I, pp. 305-307 and Appendix to Chapter VI, pp. 319-320.

relatively large amounts of leisure in order to secure a small increase in income. During good times (high income levels) leisure is valued more highly. A small amount of leisure substitutes for a relatively large amount of income.

A straight line (as represented by RS and RS[1]) indicates the various alternative opportunities of the farm family in combining leisure and income to obtain family satisfaction. The equilibrium position is that combination of leisure and income which places the family on the highest iso family satisfaction curve.

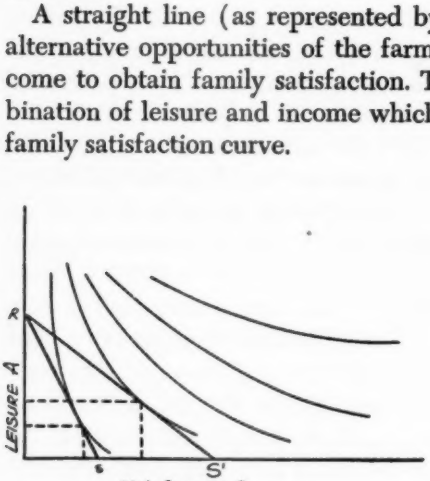


FIG. 4

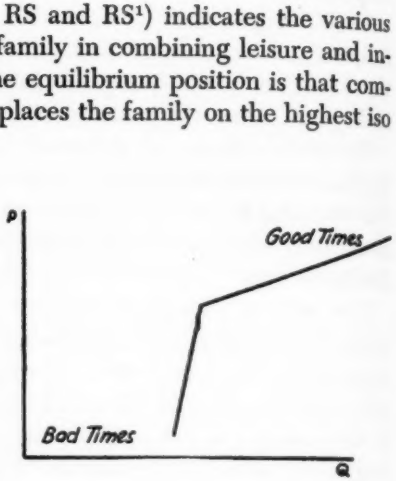


FIG. 5

The line RS is the opportunity line when times are bad, and income is low. However with a shift to good times the slope of the opportunity line decreases expressing the notion that it is easier to earn income because the price of the products has increased and that for every level of leisure the opportunity exists for more income. The opportunity line for good times is RS[1], and equilibrium is indicated with higher levels of leisure, income, and family satisfaction.

Since the opposite of leisure is effort, an increase in leisure represents a decrease in inputs of effort. With given production functions a decrease in the input of effort would be associated with a decrease in output (at least not an increase). Although the price of the product is increased, there is no reason for an elastic output response but rather the reverse.

In summary, then, the above device provides a scaffolding which permits the construction of the kinked output response. It makes clear that the kink depends upon different valuations made by the family farm entrepreneur as between bad and good times. Maximizing behavior is assumed although emphasis is shifted from profit *per se* to the maximization of family satisfactions. How realistic this formulation is with the introduction of leisure and income and the degree of generality possible must await the judgment and experience of others. It is probable that the crops and commodities for which this type of analysis is most appropriate

are those in which considerable family effort at the sacrifice of leisure is involved.[5]

Long-Run Aggregate Response[6]

The nature of the aggregative function of the output of agriculture appears also to be adaptable to a kinked hypothesis. Two changes are involved in moving from the preceding analysis to that which follows. The first involves a shift to the aggregate output of agricultural commodities from the individual commodity approach. The second is a shift from short-time considerations to long-time period considerations. And again, this aggregated kinked function is not the usual supply curve for agriculture but the hypothetical path of the response to price of agricultural output in the secular world.

In the long run we know that a farm can increase its output considerably if the conditions are favorable (good times). But in bad times, even over the long run, the output of a farm firm does not contract very much. All this implies the existence of a kink in the long run function as portrayed in Figure 5.

There appears little doubt that aggregate farm output fails to decline during bad times. However there remains a great deal of controversy regarding the reasons for this inelastic response during bad times. Fortunately this battle need not be joined here.[7]

During good times, when it is expected that relative prosperity and the higher relative prices may continue for some period of time, the output response may very well be elastic. This elastic response to a price increase in good times assumes that resources can and do shift between the agricultural and nonagricultural segments of the economy. If during good times agricultural product prices rise relatively, output should increase

---

[5] The limitations of two dimensional geometry may be removed by moving to a four variable functional model. The argument is reducible to the following sets of propositions. Family satisfaction is a function of net family income, leisure, and units of rural living. It is to be maximized subject to institutional and economic constraints on income, leisure, and rural living. The nature and level of these constraints change over time and especially over the business cycle. Thus the universe, context, milieu (or what have you) within which farmers operate during bad times is different from that existing during good times. The hypothesis presented herein is that the shift from one set of circumstances to another may be reflected in a discontinuity in the output of farm commodities.

[6] The basis for the distinction between short and long time periods is primarily the degree of certainty attached to price relationships and to the level of income.

[7] For discussion and summary of the issues involved see D. Gale Johnson, "The Nature of the Supply Function for Agricultural Products," *American Economic Review*, XL, Sept. 1950, pp. 539-564 and Earl O. Heady, *Economics of Agricultural Production and Resource Use*, Prentice-Hall, New York, 1952, Chapter 23, "Aggregate Production and Product Supply Functions," pp. 672-703.

because resources will move into agriculture under the stimulus of the price increase and reduction of price uncertainty.[8]

An issue arises here concerning the consideration to be given to technological innovation and adoption. If these are held constant in the model, output will increase because more inputs of resources of the same type are used in the present production functions. However it is conceivable that "good times" are associated with innovation and adoption of new techniques. In the latter case, aggregate output in agriculture increases because resources representing new inputs may be used in new production functions.

The second issue involves the nature of the output response depending upon the direction of the price change during full employment. Historically good times are associated with rising relative prices for agricultural products. In this case it appears that the output response would be elastic. It can be argued that in the rare case of a relative price decline in good times, the response may be either elastic or inelastic depending upon the manner in which the issue of technology is handled. It is reasonable, however, that if the price decline is believed to be fairly permanent, and employment alternatives are good, resources may shift out of agriculture, and output will decrease.

Appraisal

The test of the hypothesis of the kinked output path response will lie in its verification and usefulness. This verification may come about by statistical analysis or by reference to the combined observations and experience of many people. Previous work by others has indicated the likelihood of a kink though perhaps not in the manner formulated above.[9] Of course one

[8] This interpretation does not take into account, unfortunately, the variety of circumstances that may exist in the transition from bad to good times. It might be more appropriate to specify output in good times as being a family of curves, each curve dependent upon the relation between returns to certain factors in agriculture and what these same factors may earn outside. Although product prices in agriculture may have increased as a result of rising aggregate demand, if returns to factors are still relatively low, resources may continue to leave agriculture and output would be inelastic. However, with continuing good times, rising product prices, and hence with increased returns to factors, labor may choose to stay in agriculture and work in combination with factors brought in from outside. The output response would then be elastic as shown.

I am indebted to Dr. D. Gale Johnson for suggesting the possibility of this added refinement during good times.

[9] See L. H. Bean, "The Farmers' Response to Price," *Journal of Farm Economics* XI, July 1929, pp. 368-385. The article by R. L. Mighell and R. H. Allen, "Supply Schedules 'Long Time' and 'Short Time,'" *Journal of Farm Economics* XXII, August, 1940, pp. 544-577 may tend to support the hypothesis of the varying elasticities depicted under good and bad times.

For discussion and evidence of the implied kink in "one way" or "irreversible" curves see Geoffrey Shepherd, "The Burden of Increased Costs of Distribution," *Jour-*

problem in testing the hypothesis concerns the definition of what constitutes "good" and "bad" times as they have been used in this paper.[10]

If the hypothesis can be tested and accepted, it may have fair significance for public policy concerning the efficacy of price manipulating programs. The implication is that price may be effective in affecting the allocation of resources hence the composition of total output only under certain conditions. Specifically it appears that different price policies are necessary depending upon whether good or bad times prevail—that the price policies correct for a depression may not be desirable during good times.

If it can be assumed that times will be relatively good in the near future, then short time price increases in a particular product may not be effective in shifting resources into that product and in increasing output. This is apparent from the short period kinked function in good times. If it were desired to increase output, then the strategic factors would be the "shift" factors which position the kinked curve rather than price. These shift factors include such things as lower factor costs and technological advance. Perhaps in this case public policy should be concerned with subsidies or research and extension assistance to bring about lower factor costs and technological adoptions.[11]

On the other hand a policy guarantee of good times and good prices could shift the context to the long run. In the aggregate an elastic response of output would be expected. But what would be the result if the policy of good times were achieved only by an inflationary rise in the general price level? Unfortunately the applications of the kinked hypothesis in this paper do not include a period of inflation. But the previous discussion of the elements of output response in good and bad times should serve to point out the complexities of the problem and some of the variables involved.

The concept and diagrams of the kinked aggregate output function seem to say little more about the nature of agricultural supply than what is implied in the various writings on the subject. However the implications of these articles all seem to be embodied in the concept of the kinked output path response, and the latter is a parsimonious description of what

---

nal of Farm Economics XIV, October 1932; J. M. Cassels, "Nature of Statistical Supply Curves," *Journal of Farm Economics* XV, April 1933; and J. M. Cassels and W. Malenbaum, "Doubts About Statistical Supply Analysis," *Journal of Farm Economics* XX, May 1938.

A recent reference is Heady, *op. cit.* especially p. 678.

[10] This dichotomy may be too simple because it overlooks significant factors which are operating in the transition period and are of great interest to economists.

[11] It is entirely plausible that regional differences in output response exist. The nature of these differences would have to be taken account of in formulating the most efficient program to bring about the desired response.

seems to be taking place. Also the kinked hypothesis recognizes explicitly the importance of aggregate income as a factor affecting agricultural supply. It seems to make clearer and more precise what is involved in observations regarding the "irreversibility" of the supply function in agriculture.

ROBERT L. CLODIUS

University of Wisconsin

RURAL INDUSTRIES AND AGRICULTURAL DEVELOPMENT

MR. STEFAN ROBOCK in his article, "Rural Industries and Agricultural Development"[1] correctly concluded that rural industries, as he defined them, have little to offer as a solution to the problem of providing non-farm employment for that part of our rural population which is currently underemployed; however, the use of the concept of "rural industries" has little to offer as an analytical tool in an analysis of the location of industry.

The use of aggregates taken from the Census of Manufactures has the inherent danger of misrepresenting individual items. Of the 453 "four-digit" industries, Mr. Robock classified 41 as rural industries because they have "a major locational advantage when located proximate to agricultural raw materials, forestry raw materials, or local agricultural markets."[2] In analyzing the problem of industrial location, it is, to say the least, difficult to generalize from the individual case or from the aggregate. That is, it is impossible to conclude that those factors which are of major importance for a single firm are of comparable importance for every firm in the industry, nor can it be said that what appears to be true for the industry as a whole is true for each individual case. Mr. Robock has classified certain industries in their entirety as rural industries, and by so doing, he has magnified the significance of these particular industries and the importance of the category, "rural industries." A few examples may serve to point out the danger involved in this type of generalization.

Meat packing wholesale is classed as a rural agricultural industry as it has a "major locational advantage when located proximate to agricultural raw materials." Although the source of the raw materials is an important factor in this industry, modern means of transportation make it possible to locate some distance from the source. Chicago, for example, is "proximate" to a very large part of the Mid-west, and certainly the large meat packing plant in Chicago cannot be considered as a possible

[1] *Journal of Farm Economics*, August, 1952, page 346.
[2] *Ibid.* page 350.

source of non-farm employment for the farm population of the Mid-west. In 1947, there were 2,153 firms employing a total of 167,072 production workers in this industry, and 580 or 27 per cent of the firms located in 26 metropolitan centers employed 72,661 production workers which was 44 per cent of the total.[3] Of all the production workers in the industry, 43,990 or 26 per cent were located in the urban areas of Chicago, St. Louis, Kansas City, Minneapolis-St. Paul, and New York. At least a part of the 2,153 firms are properly categorized, but a very large part of the industry does not offer a possible source of non-farm employment for that part of the rural population which is currently underemployed.

There were 30,700 production workers in the flour and meal industry, and 10 per cent or 3,019 were found in Minneapolis-St. Paul and Kansas City. This industry is closely associated with the raw material, but modern means of transportation no longer necessitate its being located in immediate proximity to the raw materials. Although only the figures for two metropolitan centers were given, one can conclude that a large part of the milling industry does not offer employment opportunities for the farm population. It is the small rural mill which is so located that it can provide employment opportunities for the rural population, but this group is very limited in the amount of employment which it can offer.

The fertilizer mixing industry involves the mixing of the various ingredients and generally takes place near the point of consumption, but the fertilizer industry is not so oriented. As a rule, the production of fertilizer takes place near the source of the raw materials or the source of power.[4]

The foregoing three examples illustrate the fact that each industry must be carefully analyzed if an accurate estimate is to be made of the amount of employment which that industry provides for the farm population. It is an error to classify whole industries as "rural industries"; however, there are some industries for which this is an accurate description. The lumber and basic timber products industry, which consists of sawmills and planing mills, veneer mills, cooperage stock mills, and excelsior mills, is properly classified as a rural industry. This is evidenced by the fact that only 2.3 per cent of the firms employing a total of 2.6 per cent of the production workers are found in the metropolitan centers of the country. Further evidence of the fact that it is properly categorized is the fact that of the 26,231 firms in 1947, 25,954 had less than 250 em-

---

[3] Birmingham, Los Angeles, San Francisco, Chicago, Kansas City, Louisville, New Orleans, Baltimore, Boston, Detroit, Grand Rapids, Minneapolis-St. Paul, New York, Philadelphia, Buffalo, Utica-Rome, Cincinnati, Cleveland, Columbus, Dayton, Youngstown, Portland, Pittsburgh, Houston, Seattle, and Milwaukee.

[4] Arthur D. Little, Inc., *A Survey of Industrial Opportunities in New England.* Cambridge, 1952, page 198.

ployees, and the average number for those firms employing less than 250 persons was 20 employees. In addition, it is significant to note that between 1947 and 1950 there was an increase of 15,275 firms and 15,210 of these new firms had less than 250 employees.[5]

It is inaccurate to use aggregative figures in a discussion of "rural industries" because it will overstate the importance of the industries so classified. In some cases the error is of considerable importance (meat packing), and for others it is negligible (forest and timber products). A portion of each industry is not so located that it can provide non-farm employment for the rural population; so in fact, there are less than 1,200,000 persons employed in "rural industries." In order to ascertain what industries should be included in such a classification and the importance of these industries as a source of non-farm employment, it would be necessary to make a very thorough empirical study of each industry, and, in some cases, each firm.[6]

JOHN M. KUHLMAN

University of Richmond

[5] Bureau of the Census, *Annual Survey of Manufactures, 1949 and 1950.* Washington, 1952. All other figures have been taken from the *1947 Census of Manufactures.*

[6] This note suffers from the fact that the analysis is based on that material which is published in the Census of Manufactures for the metropolitan centers (40,000 manufacturing employees). To be completely accurate, it would be necessary to obtain the same information for all urban areas, but the lack of such information does not invalidate the conclusion as to the usefulness of the concept of "rural industries" as an analytical tool.

PUBLICATIONS RECEIVED

Adams, Frank, "Community Organization for Irrigation in the United States," FAO (International Documents Service, Columbia University Press, New York, N.Y.) Pp. ii, 39. $.50.

*Allbaugh, Leland G., "Crete, A Case Study of an Underdeveloped Area," Princeton, New Jersey: Princeton University Press, 1953, Pp. xx, 572. $7.50.

Beuscher, Jacob G., "Law and the Farmer," New York: Springer Publishing Company, Pp. vii, 406. $4.95.

*Black, John Donald, "Introduction to Economics for Agriculture," New York: The Macmillan Company, 1953, Pp. xv, 727. $6.00.

Branston, Brian, "Time and Motion on the Farm," London: Faber and Faber Limited, 1953, Pp. 123. 15s.

Clark, Charles E., "An Introduction to Statistics," New York: John Wiley & Sons, 1953, Pp. x, 266. $4.25.

DeVajda, A., "Some Aspects of Surface Water Development in Arid Regions," FAO (International Documents Service, Columbia University Press, New York) Pp. v, 45. $.50.

Duddy, Edward A. and Revzan, David A., "Marketing, An Institutional Approach," New York: McGraw-Hill Book Co., 1953, Pp. xiv, 644. $6.00.

Duerr, William A., and Vaux, Henry J., "Research in the Economics of Forestry," Washington: Charles Lathrop Pack Forestry Foundation, 1953, Pp. xi, 475. $6.00.

Efferson, J. Norman, "Principles of Farm Management," New York: McGraw-Hill Book Company, 1953, Pp. vii, 431. $6.00.

Finney, D. J., "An Introduction to Statistical Science in Agriculture," New York: John Wiley & Sons, 1953, Pp. 179. $3.75.

*Fisher, Lloyd H., "The Harvest Labor Market in California," Cambridge: The Harvard University Press, 1953, Pp. xi, 183. $4.50.

Kuznets, Simon, assisted by Jenks, Elizabeth, "Shares of Upper Income Groups in Income and Savings," New York: National Bureau of Economic Research, 1953, Pp. xli-725. $9.00.

McConnell, Grant, "The Decline of Agrarian Democracy," Berkeley, and Los Angeles: University of California Press, 1953, Pp. 226. $3.75.

Proceedings of the International Conference on Agricultural and Cooperative Credit, Vol. 1 and 2, Berkeley, California: University of California, 1952.

Runes, Dagobert D., "The Soviet Impact on Society," New York: Philosophical Library, 1953, Pp. xiii, 202. $3.75.

---

* Reviewed in this issue.

"Social and Economic Studies," Vol. I, No. 1, February 1953, Jamaica, West Indies: Institute of Social and Economic Research, University College of the West Indies, Pp. 119. 5/3 or $.75.

Taylor, Carl C., "The Farmers' Movement 1620-1920," New York: American Book Company, 1953, Pp. vii, 519. $5.50.

TVA, "Two Decades of Progress," Washington: U. S. Government Printing Office, 1953, Pp. iv, 76.

Upgren, Arthur, and Edmunds, Stahrl, "Economics for You and Me" New York: The Macmillan Company, 1953, Pp. viii, 246. $4.00.

Wells, Henry A., "Monopoly and Social Control," Washington, D.C., Public Affairs Press, 1952, Pp. ix, 158. $3.25.

Western Governmental Research Association in Cooperation with the Bureau of Public Administration, "Inventory of Public Affairs and Social Science Research in the Western States, 1951 and 1952," Berkeley, California: Bureau of Public Administration, 1953, Pp. vii, 113. $2.00.

Wold, Herman, in association with Jureen, Lars, "Demand Analysis: A Study of Econometrics," New York: John Wiley & Sons, 1953, Pp. xvi, 358. $7.00.

Yang, W. Y., "Farm Management Investigations for Agricultural Improvement," FAO (International Documents Service, Columbia University Press, New York) Pp. v, 36. $.50.

Zimmerman, Carle C. and DuWors, Richard E., "Graphic Regional Sociology," Cambridge: Phillips Book Store, 1952. Pp. x, 206. $3.50.

BOOK REVIEWS

Economic Organization of Agriculture, Theodore W. Schultz, New York: McGraw-Hill Book Company Inc. 1953, Pp. xx, 374. $5.50.

One of our foremost agricultural economists presents the profession, leaders of the farming community, legislators and officials of a new administration with a progress report on the important study "Agriculture in an Unstable Economy." This is a work which he had undertaken for the CED Research and Policy Committee toward the end of the war.

The new book deals eminently with agricultural policy in the broadest and boldest sense, covers an enormous range of problems—partly international in scope—but concentrates upon the American scene. The subject is approached by the use of analytical tools, models, speculative logic and hypotheses on major problems of economic dynamics rather than by critical analysis of the complex historical fabric of the existing agricultural policy or recommendations toward its amendment or reform.

Parts I and II contain a synopsis of the latest results of research on the functional performance of agriculture and the communication with the other parts of the economy. They are the foundation for, and lead in Part III to, the author's perpetual scientific, practical and political concern, advising on better policies to remedy what he considers as inadequate performance of the agricultural system and: on solutions for problems that he foresees as imminent for the future.

In Part I Professor Schultz unfolds the full array of dynamic phenomena of agriculture in a developing economy, brings into play the progress in studies achieved in recent years, partly by his school of economics. From a reserved appraisal of the political impact of a gradually diminishing rate of population growth upon the food economy, he proceeds to a detailed analysis of the changing income elasticities of the demand for food, food groups and other farm products within an expanding economy. Shifts in demand are weighed as cause for adjustment in allocation of productive resources. Other chapters weigh the impact of changes in production technology upon the input-output relations and the returns on special expenditures for research. Two further chapters deal with the disparities in agricultural adjustment within an expanding economy and with low income and poverty areas as the result of development elsewhere. The 175 pages of this part, with their bold venture in search of a theory of economic development, contain aside from a wealth of solid research results many challenging new hypotheses which before being accepted must be tested as must be many others previously presented by the author and members of his school. This applies even to the summary condensation of the Ricardo-Malthus-Mill theory of development with population growth

restoring the "equilibrium" which Professor Schultz proclaims as still valid for large parts of the world. The persistent growth of population simply militates against some underlying assumptions.

With due respect for the stimulating impact of many of the new hypotheses presented in this book, and recognizing the contribution made, the reviewer cannot but be impressed by the size of the burden which implicitly the author has put on the shoulders of others. It consists of the necessity of testing those theses by contradictory evidence as well as quantitative analysis in great detail. Many chapters of this book call for entire books with empirical as well as analytical studies by others.

To mention only one of the many hypotheses that deserve questioning and testing despite their obvious plausibility: the author proposes that one of the reasons for stagnation in agricultural development in many areas of the United States is the insufficient supply of capital for the development of human production agents. Observations in the Pacific Coast area suggest that this might not necessarily be true. Farmer immigrants from extremely slowly developing agricultural areas of Asia and the Mediterranean are among the most progressive elements of highly productive, speculative and high-income farming agriculture—long before capital for developing human agents could possibly begin to have any effect.

Part II is the most lucid, clearcut and also the least hypothesis-charged one of the book. It presents the theory of economic instability of agricultural income, exposes yield instability and its regionality, instability of prices, relative stability of inputs and production and the often peculiar shapes of producer supply schedules.

These two analytical and synoptical parts of the book contribute a great deal to the thought and discussion among those interested in agricultural economics and policy and economists will appreciate them.

Farmer leaders, businessmen, bankers, legislators, and administrators, however, will naturally be most interested in Part III. Significantly enough it does not contain the major outlines for a reorientation of our agricultural policy, except by exclusion of alternatives, by implication and reference to earlier proposals by the author.

The negative appraisal of many features of our agricultural policy of the last two decades appears in a few sentences and is plain enough: "Farm price supports and efforts to control agricultural production by acreage allotments, marketing quotas, and related public measures are not satisfactory. Diversion operations, subsidized exports, and efforts to shelter the domestic market from foreign competition are also unsatisfactory." But the proposals as to feasible alternatives are guarded, tentative and directional rather than concrete. Concerning institutional changes in agriculture for more equal development, heavier allocation of resources

to the development of new techniques and better economic information are indicated as desirable. Otherwise specific improvements in the labor market, such as better public information on jobs elsewhere are suggested. These seem feasible, though not necessarily effective. Professor Schultz still holds that agricultural development suffers from external and internal "capital rationing" and hints at the desirability of improving the functioning of the capital market. But this claim is neither substantiated nor are there hints at possible reforms in agricultural finance beyond what has been done with the Farmers Home Administration and the changes within the longer run short-term credit policy of all lending agencies.

The discussion of a better organization of agriculture for price stability is based on one side on the conviction of the priority of monetary and fiscal policy measures for preventing depression, and on the other the ineffectiveness of contraction of agricultural output by acreage allotments on the other. The main thought advanced centers around policies to increase the price elasticity of the demand for food and a greater flexibility of agricultural production. "It should be possible to increase somewhat the price elasticity of the demand for farm products and to make agricultural production appreciably more responsive to changes in relative prices."

The book does not touch upon the greater political leverage and bargaining power which agriculture would have in another depression owing to the much larger dependence on the market for inputs which result from the extraordinary phase of 15 years of accelerated development.

With the reconstruction of world agriculture now complete, American farming in the coming years will enter a period of readjustment, at which time the thoughts contained in this latest book of Professor Schultz will find due consideration. The absence of any prognostications of the income situation to be expected in the coming years as well as the reluctance to present concretely formulated blocks of measures for the reorganization of our agricultural policy fit well into the general atmosphere of immensely greater sophistication within the entire economic profession that distinguishes our day from that of the early thirties. This may imply that without saying so, the author of *Economic Organization of Agriculture* is favorably impressed by the splendid dynamic performance of American agriculture for half a generation—despite impediments arising from imperfect organization and policies—and that he is not unduly alarmed by the need for adjustment. But it also may mean that he declines sticking his neck out at this time and is keeping his powder dry for a contingency in which the need for adjustment to new price levels and changed terms of trade for agriculture may make marginal utility of new policy designs soar.

KARL BRANDT

Stanford University

Economics of Agricultural Production and Resource Use, Earl O. Heady, New York: Prentice-Hall, Inc. 1952. Pp. viii, 850. $9.75.

Professor Heady has written a highly important book—an encyclopedic work which for the first time brings within the covers of one volume the "revolution" that has occurred in the field of agricultural production economics over the past 15 years. A small group of able and venturesome workers in farm management and production economics, with the author of this volume in the forefront, have brought the "new economics" to bear on farm production problems in an original and most valuable manner. The results of these labors are brought together in *The Economics of Agricultural Production and Resource Use*. The development of the new approach in this area of agricultural economics is no reflection on the earlier and path breaking contributions of such great figures as Black, Taylor, and Spillman; nor on those of a highly original group of Europeans including Von Thunen and Brinkman. What is remarkable is that the developments of the past 15 years have influenced so little the analytical approach of the dozen farm management texts which have appeared in the past decade.

This volume treats with "production and resource relationships, the conditions under which efficiency is attained, and the behavior patterns of persons who serve as managers and administrators of agricultural resources" (p. v.). The problems both of the individual farmer and society are examined. After a one chapter introduction the book is divided into three broad sections, *viz.*, planning under perfect knowledge (chapters two to fourteen); planning under imperfect knowledge (chapters 15 to 19); and the aggregate aspects of production (chapters 20 to 27).

The two chapters following the introduction provide a treatment of the elementary theory of production economics. These present a very imaginative development of resource-product relationships, and provide a rich collection of illustrative material dealing with the input-output relationships in some dozen farm enterprises. In this alone, Professor Heady has placed college teachers greatly in his debt.

Chapters 4 to 14 present the most complete and comprehensive analysis of the economics of resource allocation which exists in the literature. This is written within the context of "static" conditions, coinciding for Professor Heady with the assumption of perfect knowledge. All aspects of the subject on which economists have anything to say are covered. This includes a chapter (11) on the peculiar nature of costs in the farm firm. It also includes a beautiful treatment of the scale problem (chapter 12) set, of course, within the assumption of perfect knowledge. A later chapter (18) picks up the same subject under the assumption of imperfect knowledge. It draws together the accepted theory and concludes that, in contrast to the situation prevailing under conditions of certainty, uncertainty does

limit size. The implications of equity financing and capital rationing on scale are considered. These are respectively treated as (1) the entrepreneur's and (2) the lending agency's response to uncertainty.

The section of the book dealing with planning production and resource use on the individual farm under conditions of uncertainty is most significant. Here the author gets down to an analysis of (1) function and nature of management, (2) the adjustment of production to uncertainty, (3) size of farm (already noted), (4) and farm ownership under conditions of uncertainty.

Of greatest interest is the last section of the book—that dealing with the aggregate aspects of farm production and which, in consequence, focuses on policy issues. Here chapters deal with leasing and tenure systems, with the location of production (inter-regional specialization), aggregate and product supply functions, efficiency, conservation, and technological change. It should not be thought that Professor Heady's failure to describe in precise terms a long run supply function for American agriculture, or to carry his treatment of conservation as far as definite policy recommendations constitute a shortcoming in his work. This is a volume on economic analysis, not on economic policy. In dealing with each of the subjects enumerated above Professor Heady very properly emphasizes the important theoretical issues which must be taken account of in developing policy recommendations. He achieves this most skillfully—a fact which makes these chapters particularly instructive reading. He goes furthest toward policy proposals in his handling of the efficiency problem in agriculture.

However, it should not be thought that merely by applying the methods developed by the author precise policy prescriptions will emerge. The field of study, and the best methods available, just do not lend themselves to any such results. And even though the reader may feel we are little nearer solutions to the fearful problems of farm production, resource use, and policy as a result of recent developments in the field, we are at least on surer ground. Our definition and understanding of problems is more revealing; and our tools sharper. For these advances we owe a tremendous debt to Professor Heady.

A reviewer would perform a disservice if he failed to state that there is nothing in the text of this book to frighten off the reader who finds much of the mathematics which is increasingly taking over economic journals beyond his depth. Professor Heady has relegated mathematics to footnotes—and an understanding of the text does not require comprehending the footnotes. The volume is attractively printed and bound and the tables and charts nicely conceived and executed.

DAVID L. MACFARLANE

Macdonald College, McGill University

Introduction to Economics for Agriculture, John Donald Black, New York: The Macmillan Company, 1953. Pp. xv, 727. $6.00.

Teachers of undergraduate students in economics always face the real difficulty of arousing interest in the subject matter and training students in abstract reasoning. The first requires repeated reference to the personal experiences of students and a good insight in human aspirations and social values; the second requires the fitting of empirical observations into the framework of rigorous logical thought. In *Introduction to Economics for Agriculture,* Professor Black has been singularly successful in overcoming this difficulty.

The book has the warm human touch of a social scientist who really cares about the welfare of people; it also has the lucidity which systematic classification and theoretical analysis impart to inquiry into the complex socio-economic reality of modern days. The text is written in a lively and straightforward way, and friends and former students of Dr. Black will recognize many of the idioms peculiarly his own.

The nine major parts of the book are somewhat uneven in degree of detail and incisiveness of argument. The scope of the book makes this almost inevitable. Yet I could not help feeling that some things were overly detailed while others were drawn too sketchily. This is nothing, however, that a moderately good teacher could not readily correct in the conduct of his course.

Part I, Orientation, includes seven chapters which outline basic concepts in scientific method and its application to economics, describes the general role of agriculture in the whole economy, and presents a good picture of the major institutions within which economic activity and change take place. "This book is a book on *private* economics as well as on *public* economics . . . it analyzes the economics of the individual farm . . . as well as the economics of national production, marketing and credit programs. . . . This does not mean, however, that the economics of public affairs is slighted in this book. It is analyzed in parallel with, instead of largely in place of, the economics of private affairs. The author holds that neither is well understood without the other" (p. 92). He goes on to say that it is most important for the future of democracy and our form of government for individuals to grasp the needs of community welfare, progress and safety, and to be aware of one's social responsibility as a necessary counterpart of freedom.

In applying this approach, the discussion of problems of the firm is followed, in most of the relevant chapters, by a discussion of parallel problems of aggregate or macro-economic nature—though usually with considerably less detail.

Part II deals with Production, Part III with Consumption, and Part IV with Commodity Distribution. The exposition of the analysis is conventional, but the selection of examples, and the opening up of vistas into the complexity of economic, social and political interdependencies is done with constructive and disciplined imagination. The same holds for Part VII on Land Economics, dealing with land use, tenure and credit. The parts on Money, Banking and Credit, Income and Its Distribution and International Economics are designed to give the student a concrete feeling for the tremendous dependency of modern commercialized agriculture upon general national welfare and world trade. The last part, on Public Economics, gives a brief history of U. S. agricultural policy since World War I, and ends, with a bit of an anti-climax, with a chapter on Public Finance which might have fitted better in Part V.

This book should be welcomed by students and instructors alike. It sparkles, in many places, with the wisdom of a great humanitarian and the insights of a keen observer.

RAINER SCHICKELE

North Dakota Agricultural College

Resource Conservation: Economics and Policies, S. V. Ciriacy-Wantrup. Berkeley and Los Angeles, University of California Press, 1952. Price $6.50.

Probably no term in economics has become more hallowed to the non-economist than the word "conservation." Intellectuals and "do-gooders" have flocked to do battle for it against the legion forces of "exploitation," and "waste." Statesmen and politicians have taken up the cause. In some cases they have done so because of a sincere and proper belief in the evils of permanently destroying that which cannot be replaced, in other cases because being for "conservation" and against "wasteful use of resources" has all of the political appeal of being for virtue and against sin. Numerous volumes, ranging from poems and novels through polemic essays and psuedo-scientific treatises to careful, objective studies, have appeared eulogizing "conservation," and telling how to attain it. At least half of the annual expenditures of the United States Department of Agriculture (excluding price supports) are allocated to programs which are wholly or largely concerned with "conservation."

Yet the very popularity of the concept has led to an acute problem. Hallowed though it be, the term "conservation" has come to have no concise meaning, only a hazy aura of righteousness. "Conservation" has become not only the antithesis of "misuse," but often also even of "use." To its enthusiasts it has sometimes become an end in itself, rather than

a means towards the ultimate end of a high and increasing standard of living for the nation and the world. In politics "conservation" stands now as a watchword, under the cloak of which to give subsidies, build political empires, and vilify any who raise a voice against "conservation" proposals regardless of what is being dubbed conservation.

No doubt it was with these factors in mind that the California Agricultural Experiment Station, in 1938, began a long range research project on the subject of conservation. Both the Social Science Council and the Guggenheim Foundation have assisted in financing the work. Publication of *Resource Conservation*, by S. V. Ciriacy-Wantrup, Professor of Agricultural Economics at the University of California is a direct result of this study.

Professor Ciriacy-Wantrup's first move, after setting the problem and stating his objectives, is to define conservation. This is the key to the entire work. While not unique, his definition is, none-the-less, satisfying to an economist. Whether it will be either understood or accepted by non-economists is another question, and a serious one.

"Conservation," Professor Ciriacy-Wantrup states quite simply, "is concerned with the when of use." "In conservation, the redistribution of use is in the direction of the future, in depletion, in the direction of the present." This is the heart of his "dynamic interpretation" of conservation. For economists, the author becomes somewhat more explicit as to the quantitative measurement of conservation, but that is actually only detail. The central point is the definition of conservation, and its opposite, depletion, in terms of "changes in the intertemporal distribution of use."

With such a definition, much of the "glamour" and ethical aspects of conservation are foregone. No longer is "conservation" a hallowed be-all and end-all. No longer is "depletion" a synonym for waste. Conservation becomes largely a matter of time preference. And whether to "conserve" or "deplete" at any given time is no longer a choice between whether to "serve or to sin." Rather, it is a decision which a rational entrepreneur or society must make in the very same manner any other decision in resource allocation must be made.

Having defined conservation, Professor Ciriacy-Wantrup embarks upon a discussion of the "Private Economics of Conservation," or the economics of conservation from the standpoint of an entrepreneur in a profit economy. Here he first takes up conservation decisions and the optimum state of conservation. Then, with an unusual singularity of purpose, he investigates the effects of various economic forces upon private conservation decisions. The interest rate, time preference, income uncertainty, prices and price supports, property and tenure institutions, credit, taxa-

tion, market form and economic instability are all considered, each in the context of its effect upon the entrepreneur's decision of whether to conserve or deplete in order to move toward the optimum state. These are among the most interesting chapters in the entire book, and while nothing startlingly new turns up, the analysis is logical and complete.

Next comes the "Social Economics of Conservation." This is divided into two sections, "Criteria and Objectives of Conservation Policy," and the final chapters in the book, "Implementations of Conservation Policy." In the first of these sections, the author arrives at a "safe minimum standard" of conservation, which he holds as an objective of intelligent conservation policy from the social standpoint. This standard, too, should be satisfying to most economists. It is achieved by "avoiding those physical conditions, brought about by human action, which would make it uneconomical to halt and reverse depletion." The last few chapters are concerned with the various domestic and international tools of conservation policy.

All-in-all, Professor Ciriacy-Wantrup has contributed a comprehensive treatise on the economic theory conservation. None of his concepts are new, but they are sound. Throughout, he has maintained a logical consistency and a unity of purpose which is both effective and refreshing.

Professional economists who have not recently or ever thought through the various facets of the economics of conservation will find the book valuable in providing a sound conceptual framework. Even for those who have given the matter considerable study, Professor Ciriacy-Wantrup ties together a number of loose ends. Advanced students of agricultural economics will discover the work an excellent exercise in logical economic reasoning.

But whether *Resource Conservation* will be able to reach and enlighten those outside the field of professional economics is another question, one which the reviewer feels must be answered pretty much in the negative. The analysis, though simply stated in general, is rigorous enough to be beyond the easy understanding of most not specifically trained in economics. Most of "conservation's" loudest exponents, as well as the average citizen who has become "conservation" minded, would fail to grasp the real importance of much of the analysis. And many "conservationalists," along with some in political or administrative life will deny Professor Ciriacy-Wantrup's definition of conservation, excellent though the receiver considers it, thus making any real contribution by the rest of the analysis improbable, if not impossible.

The real mission of *Resource Conservation*, then, must be considered to educate the educators. This in itself is most important. Many professional economists are quite hazy in their thinking on conservation. They can be

counted upon to save few souls till they themselves have firmly grasped the correct principles. Professor Ciriacy-Wantrup's volume should do much to set them on the right track.

But, in reality, it is only a beginning. The problem of conservation policy is acute. The time is fast approaching when some definition and concepts of conservation must be agreed on by lay-people in government and elsewhere, or the situation will approach the chaotic. The present Agricultural Conservation Program of the U.S.D.A. is a case in point. Even if the administrative details were smoothed out to perfection, a definite question would arise as to whether the payments to farmers were being made for truly "conservation" practices, or what Congress had in mind by "conservation" in the first place. In many ways, it reminds one strongly of the Tower of Babel.

Let us hope, then, that Professor Ciriacy-Wantrup, those who backed him, and others will consider this only a first step, which, though firm and basic, requires many long strides to follow it before the mission is finally accomplished.

JOHN W. HICKS

Purdue University

The Canadian Grain Trade 1931-1951, D. A. MacGibbon, Toronto: University of Toronto Press, 1952. Pp. 227.

A further contribution by Professor MacGibbon to the literature describing and analyzing developments in this field. It is a welcome addition to his earlier work *The Canadian Grain Trade* published in 1932, since it will serve at least two purposes. For students of the pricing and marketing of Canadian grain it will provide a useful reference volume, and for those interested generally in the kinds of programs that may be devised to deal with an export crop produced under high risk conditions it will be a useful case study.

Professor MacGibbon has done an able job of describing the sequence of events during the past twenty years leading to the development of the present system of marketing Canadian wheat and coarse grains. He has discriminated carefully in the selection of important developments to be included. He has attempted to determine the reasons for many of the most significant steps, both political as well as economic, and has also appraised the implications of the various programs and discussed some alternatives.

Under the present program the Wheat Board takes title to all commercial farm deliveries of western wheat, oats and barley using the existing grain marketing organizations as its agents up to the point of sale by the Board. Separate grade and condition pools are established and the

proceeds of sales for each pool less administration, transportation, and handling expenses are reflected back to participating farmers.

Canadian Wheat Board wheat pools have served not only to remove variation in returns from time of sale within the pool period but also differences in prices charged different markets. During the recent four-year International Wheat Agreement, for example, federal policy has been to offer wheat to be milled for domestic consumption at the same prices as those governing I.W.A. sales. Sales of milling grades for export outside the provisions of the I.W.A. and of low grade wheat have been made at prices determined by the Wheat Board on the basis of their appraisal of market conditions. Since I.W.A. prices have been below prices charged by the Board for export sales not governed by the I.W.A., the two-price program has not maximized producer returns by taking advantage of an inelastic domestic market. The effect of keeping domestic prices in line with the lower of the two prices charged foreign purchasers has been to forestall criticism that Canadian consumers are being unfairly treated or the I.W.A. is being used as a means of dumping wheat abroad. The administrative problems that might arise if domestic prices exceeded the final pool price have also been recognized.

MacGibbon also describes the changes in proprietary and cooperative organizations engaged in marketing grain. The importance of the latter in both physical handling and policy determination is described. The three provincial farmer cooperatives, for example, physically handle between one-third (Alberta) and one-half (Saskatchewan) of all commercial grain deliveries in their respective provinces and the total marketings of their members exceeds these proportions. They whole-heartedly support the present system of marketing which represents the achievement of a goal for which they have struggled for many years.

Some major conclusions drawn from this study are that Canadian national wheat policy has been largely shaped to deal with problems as they arose, that experience to date has not proved long-term intergovernmental agreements are advantageous to western wheat producers, that marketing methods are only one aspect of a larger problem, and that the interests of western Canada would best be served by circumstances that contribute to the freest possible international exchange of goods and services.

These conclusions imply criticism of the existing marketing system not fully justified on the basis of the historic evidence to which MacGibbon has largely restricted his study. Sound criticism and valid policy recommendations generally require more than the examination of historic evidence alone, and this would necessitate a broader study than MacGibbon has undertaken.

The value of this book lies primarily in its description of developments

in Canadian grain marketing and pricing over the past twenty years. In view of this the fact that some of the conclusions may not follow logically from the evidence presented is a minor deficiency.

R. B. How

University of Saskatchewan

Planning One Town, John D. Black and Ayers Brinser, Cambridge: Harvard University Press, 1952. Pp. 75.

Planning One Town is a 75 page pamphlet written especially for the people in the Town of Petersham, a hill town in Massachusetts. Its objective is to furnish a basis of fact and an analysis on which the people of that town may ". . . be better able to chart a wise program of action. . . ."

The pamphlet has five chapters. The first, "The Town and Its Problems" contains primarily notes on the historical decline in agriculture in the town since 1840. A few tables of census data are used to help present the current situation with respect to number of farms, population, land use and ownership. Chapter 2 deals with the "Agricultural Possibilities" in the town—soils, markets, farm organization and residential farming. Five farms were analyzed. A farm plan for each was worked out to show the increased return to the farmer if he used the most advanced techniques. This chapter contains some of Prof. J. D. Black's major ideas such as (1) "We are not 'one world' in matters of food supply" (p. 28); and (2) food and fiber for the increased U.S. population of the future "can be produced more advantageously . . . by increasing the yields per acre of land now in crops and pasture rather than by bringing abandoned farm land back into use." (p. 29) The general conclusion seemed to be that potential income increases in agriculture are modest and no significant increase in the number of farms, except "residential farms" should be encouraged. This rather bleak outlook is tempered by Prof. Black's pride in his own accomplishments as a part-time farmer: to wit he "spends, in addition to a 50 to 60 hour work-week 11 to 12 months of the year, enough time on a city lot adjoining his home to grow more fruit and vegetables than a small family cares to consume in season, and over the winter in the case of small fruits. He grows eight species of small fruit, and five of orchard fruit plus asparagus and rhubarb." (p. 33)

Chapter 3 is on "Woodland Possibilities" and deals mainly with the projected returns from a typical 1900 acre tract by 10-year periods for seven different management plans assuming constant and rising prices. Five out of seven of the management plans yielded a net return after 30 years and two after 20 years. One of the major limiting factors to farm forestry is and has been the individual's reluctance to invest now in an enterprise which will yield a net return several decades hence. Ideas on this subject in this or any other publication would have been extremely valuable.

"Industrial, Recreational and Residential Possibilities" are the subjects of the five pages in Chapter 4. Chapter 5 is devoted to "Government Aspects." It contains a rather general discussion of the question of whether to combine, change the form or reduce the services of town government. School consolidation was carefully considered and an estimate of the costs of continuing under the present organizational arrangement was compared to the costs of one plan of school consolidation.

A number of reports of this kind have been published in the last 25 years. It is difficult and oft times impossible to appraise the value of these publications except as a part of the subsequent action which is taken by the people in the town. The generalizations that can come from studies of this kind are usually of two types. One concerns the procedures by which the technical analysis is woven into the thinking, judgments and actions of the community. The other is in the realm of ideas growing out of the analysis which may be used or tried out in many other areas.

The pamphlet contains nothing on the first and very little on the second. However, the authors should be commended for their attitude in presenting the report to the people of the town of Petersham. Although the title indicates *a plan* would be presented, they emphasize over and over again that they are merely presenting some alternatives—the consequences of certain actions. Choosing the course of action is not for the technician or any other individual. Rather it is a group action by the persons and agencies most affected. Only on this premise is development possible in a democracy.

RAYMOND J. PENN
LARRY KRISTJANSON

The University of Wisconsin

Preliminary Report on the World Social Situation, United Nations. 1952. IV. 11 (September 8, 1952). New York: Columbia University Press Pp. v, 180. $1.75. (U.N. Document No.: E/CN.5/267/Rev. 1)

It is very tempting—while discussing this *Preliminary Report*—to give forth with one's own views on Malthusianism or Neo-Malthusianism. Since this reviewer has however little new to say on that topic, and certainly nothing that would approach Lord Russell's brilliant Essay on Population (1951), suffice it to note that those who are interested in the relation of population growth and food resources will find up-to-date material in this unique document.

The *Preliminary Report* is not based "on new or original research data" and its main value does not lie in bringing to our attention facts previously unknown, though it does bring up to date statistics such as population estimates. But its value lies in pooling the work and findings of a number of international organizations—the World Health Organization, UNESCO, ILO, FAO—and in giving a picture of great scope and breadth of the

success, or failure, of humanity's search towards health, wealth and happiness.

In organization and content, the Report has similarity with the National Resources Committee Report of 1938 on the Problems of a Changing Population. The latter deals primarily with the relation of population changes to physical welfare, education and culture in the United States, while the United Nations document is somewhat less analytical but has a wider scope since it deals with the social situation of the entire world population. The document also is restricted to an *exposé* of existing social conditions and does not analyze governmental programmes to improve those conditions. It promises an adequate discussion of such programmes in another volume. Presumably this is the reason for considering this a "preliminary" work, because there is a great deal of finality in its content.

In this connection, the reviewer finds it regrettable that the United Nations document [E/CN.5/208] which gives "a detailed description of the origin of the project and the early views expressed by member States" leading to the publication of the *Preliminary Report* is not for sale and can be obtained neither through the publisher nor directly from the United Nations nor through inter-library loans from those libraries which serve as depositories for United Nations documents. The views contained in that document would probably throw light on the background of this significant work as well as on the use to which the member States believe it can be put.

The *Preliminary Report* is a balance sheet of the status of the world population, now estimated at 2,430 millions increasing yearly by roughly 30 million (Chapter II), and the primary factors which affect the level of living in the various nations, regions or continents. Health, Food and Nutrition, Housing, Education, Conditions of Work and Employment, and Special Circumstances, such as old age, refugees and physical handicaps, are taken up in Chapters III-VIII. The chapter on Health, which analyses the relationship between disease and production and income, and the chapter on Education make particularly interesting reading. Chapter IX on General Levels of Income and Welfare contains a discussion of per-capita-income as a measure of levels of living, of income distribution and of the usefulness of income statistics to various social statistics, such as population data. While throughout the *Report* there is an emphasis on conditions in economically less developed areas which are appraised in the light of achievements reached in the nations of the western civilization, Chapters X-XII deal more specifically with the problems of Latin-America, the Middle East, and South and South East Asia.

This complete survey, better than the pictures one gets from individual surveys, brings out dramatically the seriousness and appalling magnitude

of social world problems. "The world's population . . . has recently been growing at an accelerated pace. . . . The problem of supplying sufficient food for the rapidly increasing numbers is urgent and fundamental." (p. 21) On the other side of the ledger is a "markedly deteriorated" food consumption pattern both quantitatively and qualitatively, widespread lack of housing facilities and health. What is most frightening, is the outlook on mankind's fate should another war of the magnitude of world war II develop. While it will probably not succeed in reducing to any "satisfactory" degree the population numbers, it will most probably diminish to a remarkable extent the ability of the "rich" countries to support the "poor" ones which, more than ever, depend on the former for additional food supplies, medical, technical and financial assistance. Already "the gap between the rich and the poor countries in general levels of production and consumption is wider than before the Second World War."

ERNEST FEDER

South Dakota State College

Land and People in the Philippines, J. E. Spencer, Berkeley: University of California Press, 1952. Pp. 282. $4.50.

One of a series of inquiries sponsored by the Institute of Pacific Relations during the past two decades into the basic problems of land use and rural social and economic problems of Asian and Pacific countries. Previous studies have dealt with China, Japan, Korea, Indo-China, Australia, New Zealand and Indonesia.

The author spent several months in the Philippines and, in addition to firsthand observations, has used many official and secondary sources for his supporting data and documentation.

This reviewer, after nearly two years in the Philippines as Chief of the Mutual Security Agency's Special Technical and Economic Mission, finds this volume a very concise and accurate analysis of economic and social conditions and problems in the Philippines. With very few exceptions, the observations and conclusions related by the author are those which this reviewer supports. These exceptions include the alleged decline of the influence of the church and the importance of mechanizing Philippine agriculture. The church is still a great and powerful influence on the life of the people, both rural and urban, and mechanization of Philippine agriculture must come gradually and concurrently with many important economic and social adaptations.

The volume covers all important segments of the Philippine economy, beginning with an analysis of the basic structure of the economy, followed by an analysis of basic regionalisms over the more than 7,000 islands. Chapters are devoted to population growth and standards of living; soils,

techniques, and the pressures of men upon the land; and balance in domestic food supplies; transportation; the balance in interregional trade; future competition in agricultural and mineral exports; land ownership, tenancy, and credit problems; internal colonization; irrigation; rural mechanization; plant and animal breeding; rural health; governmental services; and a program of action to remove the main causes of discontent and low living levels. The chapters are especially well written and supported by the best data available and give a clear picture of the problems of population growth, food supply, diversification of industry, and balance between exports and imports. A very scholarly, thorough, highly professional job appears to have been done.

Students who have analyzed the basic natural resources of the Philippines and have considered population trends are convinced that the Islands can support a much larger population with a reasonable standard of living if more modern techniques in agriculture and industry are adopted. Fortunately, the Philippines has undeveloped soil and mineral resources which make the prospect of higher living levels bright.

Spencer's volume emphasizes the great importance of agriculture in the Philippine economy and the necessity to improve agricultural production and efficiency. This is in keeping with the U.S.-Philippine joint economic development program since nearly two-fifths of the funds and staff in this program are being devoted to agricultural projects. These projects have three principal goals: increased food production, increased production of export crops, and improved economic and social conditions for the people who live in the barrios (or villages). Progress to date justifies an optimistic view that the Philippines has a bright future, provided certain basic economic and social reforms along the lines pointed out in the volume are effected.

The last chapter in the volume, "The Elements of a Program," emphasizes the types of projects which the author believes would substantially improve the economy. Many of these are included in the current MSA program. First and foremost is land survey and classification of public lands to speed settlement and title clearance of large undeveloped areas in Mindanao. Others include extension of irrigation, both pump and gravity systems; improved landlord-tenant relationships and increased ownership of farms by operators; extensive building and maintenance of roads, ports, and airfields; expanded research and development of crops and animals, including disease and pest control and improved farming practices; strengthening of offerings in agricultural and vocational high schools, and at the college of agriculture at Los Banos; public health program support, especially for malaria control, reduction of tuberculosis, and improved water supply and sanitation; tax and fiscal reforms; establish-

ment of adequate rural credit facilities and development of strong farmer cooperatives, and stimulation of decentralized, light and secondary aspects of industrialization for diversification and increased employment opportunities for the growing population.

Many of the above projects are already in process and much more progress has been made in some than in others. The observation that "The U. S. can start the program but Filipinos themselves must pick it up and carry it forward energetically and efficiently if lasting progress is to be achieved," is indeed a sound one. It is not so much a matter of knowing what to do as of getting it done. Certainly the duties, authority, personnel, and funds of several government departments, particularly the Department of Agriculture and Natural Resources and the Department of Public Works and Communications, must be enlarged as the first step in the long-range solution of the basic problems facing the rural people.

It may take longer to get the job done by operating through these regular departments of the government, but our MSA program has consistently followed this policy rather than creating new institutions such as special government corporations. The record of such instruments has not been good. Our program may not show maximum immediate, dramatic results, but we are convinced that in the long run, it will achieve maximum beneficial results with least errors, waste, and expense.

ROLAND R. RENNE

Manila, Philippines

The Harvest Labor Market in California, Lloyd H. Fisher, Cambridge: Harvard University Press, 1953. Pp. xi, 183. $4.50.

By concentrating on the largest sector of the California agricultural labor market—the harvest labor market—Professor Fisher presents a concise analysis of the economics of agricultural labor problems that have long been controversial in California. In the first chapter, he describes the predominance of harvest labor requirements as a share of the total labor required in California agriculture, the harvest labor force, the structure of the market, the character of demand and supply, and the special characteristics of the harvest operation. To simplify the analysis Professor Fisher makes three assumptions about the harvest enterprise: (1) the economic decisions about harvesting are separate from the earlier decisions regarding planting and cultivating; (2) the total harvest cost is labor cost; and (3) harvest labor is paid piece rates. These simplifications place the "essential elements of the farmer's employment decisions in proper focus."

Chapter 2 is devoted to a history of contract labor, the predominant method of recruiting and employing the harvest labor force. In a few pages the reader is given a summary of the history and character of con-

tract labor in California. The special services provided by the labor contractor, which have enabled him to persist, are analyzed in detail in chapter three. Although the employer could perform these services, the contractor endures because he (1) has a comparative advantage in performing the services and (2) is insurance against union organizations.

Wage fixing by employers' associations and the employer opposition to union organization are, in chapter 4, traced to economic forces that impinge on the operators under the current method of operation. The author makes no pretense that economic motives explain the whole of employer behavior, but by using the assumptions made about the harvest enterprise, he explains employer behavior in terms of the economic situation faced by him. Aggregate demand is fixed by the size of the crop; revenue and cost curves are parallel and perfectly elastic. Thus, there lies between cost and revenue curves a zone of profit. In this situation there are no diminishing returns to labor; a rise in piece rates does not reduce the amount of employment offered. There is nothing to keep labor, if sufficiently organized, from bidding wages up to the revenue line. On the other hand, this same situation makes a maximum supply of labor desirable from the employer's point of view. Profitability of the harvest enterprise depends upon the ability of the employers to keep labor costs down. Out of this situation grew the numerous employer organizations which have as their object wage fixing and labor procurement, which the author analyzes in detail.

The author warns against drawing wrong conclusions "from the pervasiveness of employers' wage-fixing organizations. Although their influence upon wage rates is certainly considerable, they are far from being completely effective." He maintains that with a few exceptions they have no mechanism for enforcing their wage agreements. Further, workers have certain advantages; the crops are perishable; the undifferentiated character of the labor force enables workers to take advantage of any difference in wage rates; and employer wage agreements usually cover an area less than the labor market.

Admitting these advantages in the employees' favor, this reviewer questions the statement that employer wage-fixing practices "are far from being completely effective." In the first chapter the author made a rough comparison of the daily wage rate of farm labor in California in 1940 and the wages of common labor in California industry in 1940. The rates were $2.85 and $4.72, respectively. The enforcement of wage agreements may not be completely effective, but the over-all objective of controlling labor costs appear to be achieved. Fisher failed to note clearly that the current employers may not be deriving any advantage from the lower wage rates

in agriculture. To the extent that the differential wage rate and the availability of a seasonal labor supply have been capitalized in the land values, current operators may not be getting a significant benefit from them. While it is convenient to consider the harvest operation as a separate enterprise, we must not allow this simplification to cause us to exaggerate the size of the zone of profit between the revenue and cost curves. Cultivating and planting costs and rent or return to capital must be paid from the profit so calculated; thus there is pressure on operators to keep that profit area as large as possible. Further, labor costs are the major costs and the only costs over which they have any considerable control, hence the wage fixing.

Not even when the government assumed some of the responsibility in the determination of agricultural wages, detailed in chapter 5, was the basic pattern of wages and control over wages significantly changed. The evidence presented in chapter 5 inclines one to be cautious in urging wage boards in California agriculture.

Professor Fisher's conclusion is not an optimistic one. Reviewing the Report of the President's Commission on Migratory Labor and the Report of the Governor's Committee to Survey the Agricultural Labor Resources of the San Joaquin Valley, he notes that the structure of political power in California is such that little will be done to implement such suggestions as were made by investigating groups. He sees a vague hope in mechanization with consequent dwindling demand for labor in agriculture.

Neither Professor Fisher nor anyone else has provided an easy means of removing from the social and economic pattern of agricultural production a low wage rate and a seasonal labor supply.

JOHN W. MAMER

University of California
Berkeley, California

The Impact of Fluctuations in National Income on Agricultural Wages and Employment, Howard L. Parsons, and *The Organizability of Farm Labor in the United States*, Alexander Morin, Harvard Studies in Labor in Agriculture, Nos. 1-HL and 2-HL, Cambridge, Mass., June 1952, pp. 58 and 102.

These are the first two bulletins in an announced series of 13 studies dealing with labor in agriculture. These studies were made under the direction of Professors John D. Black and John T. Dunlop and were financed by the Ferguson Foundation. The series "consist in part of case analyses of the integration of labor and machine use and in part of analysis of the functioning and integration of agricultural labor in our total economy."

Parsons' study addresses itself directly to the objective "to discover how changes in the national income affect wages and employment in agriculture, not only the extent to which they do this, but through what channels." His analysis is based largely on BAE estimates of farm employment, wages, income, and migration, and on National Industrial Conference Board and BLS estimates of nonfarm and total labor force, wage rates and income. The time period covered is 1910-45 in most of the series.

Parsons' approach is broad and at the same time his analysis is direct and succinct. He concludes that the effect of national income changes on farm employment and wage rates depends on the level of national income and amount of unemployment in the total economy. When national income approximates the "normal" level moderate changes in either direction have little or no effect on wages and/or employment in agriculture. When national income is very low, any improvement increases both the level of wages and the number of persons employed. When it is very high, further increases in national income lead to higher wages and lower employment in agriculture, due to the acceleration of migration from farms.

Morin's study is largely descriptive. He relies heavily on the Jamieson bulletin published by the BLS for his historical material and on the Census, BAE, and BLS for statistical description.

Morin examines various factors that affect the organizability of agricultural workers. He treats in some detail the history and prospects of unionization of agricultural labor in six type-of-farming areas of the United States. He concludes that "The areas where organization is most likely ... are those where the industrialization of agriculture has proceeded farthest. Specifically, this includes California and Florida, and areas of labor-intensive farming near industrial centers, such as on New Jersey vegetable farms and on large dairy farms near cities. Both the range livestock area and the Delta plantations also have possibilities for union organization, although in each case certain special problems of attitudes must be overcome."

Both of these bulletins, and especially Morin's, suffer from poor printing. They are full of typographical errors and the charts and tables in Morin's report are about the worst this reviewer has ever seen come out of a respectable press. It is to be hoped that future bulletins in this series will get better treatment by the Harvard Press.

The most significant thing about these two reports and the program of work in farm labor at Harvard is that attention, long overdue, is being focused on this subject in a center of graduate training in economics. Dr. Black and Dr. Dunlop are to be congratulated for developing this program of study and research in agricultural labor and wages.

LOUIS J. DUCOFF

U. S. Bureau of Agricultural Economics

Crete: A Case Study of an Underdeveloped Area, Leland G. Allbaugh, Princeton, N.J.: Princeton University Press, 1953. Pp. xx, 572. $7.50

Many survey teams and advisory missions have been sent by United States and United Nations agencies to study and make reports on problems of particular foreign countries. None of their reports add so much to our basic knowledge of the structure of the area and the living of its people as is provided by this report of the team sent to Crete.

At the same time it is regretted that the work of the Crete mission did not do more on the logical next step and develop an action program based on this detailed information. Recommendations are both explicit and implicit in the report but the reader is left with the impression—here are the facts and data on Crete, take these and try to work out a program for improving conditions.

The Crete Survey was sponsored by the Rockefeller Foundation at the request of the Greek Government. Mr. Allbaugh directed the field work in Crete from May to November 1948 and the subsequent analysis and summary of the material. A particularly large number of technical people were brought in to assist in the work, both from Greece and from other areas.

The first three chapters (38 pages) summarize the detailed sample survey, discuss Crete and its problems and possible lines of action.

Part II contains eight chapters on resources, the family, food and nutrition, health, community facilities and levels of living, government, agriculture, and industry and commerce. These provide details on the individual family, farm and community surveys plus pertinent information from other sources.

Part III (250 pages) is a series of appendices detailing the statistical methodology and schedules developed for sampling this foreign area. It is particularly worthwhile as an example of the application of modern statistical design to an area where sampling problems are difficult and the available material for stratification is limited. The schedules used are interesting as suggestive of the vast differences in conditions as compared to the United States and of the breadth of the information requested. Respondents were asked questions ranging from age and composition of the household, income, food intake, food practices, home handicrafts, farm production and farm practices, health conditions and facilities, ideas about causes of disease to patterns of community visitation and social events.

This wealth of material is summarized in Part II. It certainly provides a far stronger basis for generalization on the problems and conditions than have been available to other survey groups in underdeveloped areas. The wording of certain sections suggests that the survey supplied informa-

tion which was counter to some previously held notions of Greek officials and possibly members of the team. In any case it provides a strong factual basis for developing action.

Chapter III provides some leads as to lines of action. Some involve substantial changes in existing patterns of operation, such as the proposed decentralization of governmental authority from Athens. Many useful suggestions as to detailed work with local people on improvement of agricultural practices, preventive medicine, water supplies and simple industrialization are made. The present reviewer whole-heartedly agrees that such simple approaches are an essential part of a development program. But there is still much detailed searching into attitudes of local people and government administrators needed before sound recommendations for an action program can be made. This apparently was not done.

Specific operational procedures for dacus fly control, for expanding the use of the already available improved varieties of wheat, oranges and olives, for the more efficient and less wasteful use of irrigation water, or for implementing preventive medical techniques are needed. Perhaps these are the tasks of the agencies who have followed the Rockefeller Foundation. Nonetheless the separatism which commonly afflicts the operations of the several U. N. and U. S. agencies suggests that the opportunity to develop an over-all detailed action program should have been seized upon by this survey group which had at its fingertips information on so many different aspects of life in Crete.

LAWRENCE WITT

Michigan State College

HAROLD HEDGES

Harold Hedges, 57, who died on May 18 at his home in Chevy Chase, Maryland, was born on a farm near Indianola, Nebraska. His first work with cooperatives came in 1914 as Assistant Manager of the Red Willow Equity Exchange at McCook, Nebraska. His undergraduate work in agriculture at the University of Nebraska, from 1916 to 1921, was interrupted with a year in Military Service. In 1921-22 he was employed on survey work in farm management and farm marketing in South Dakota. He completed work for the Master's degree at the University of Nebraska in 1924. After a year at Kansas State College, he was until 1934 Assistant Professor and later Associate Professor of Rural Economics at the University of Nebraska. He carried on graduate studies at the University of Minnesota in 1931-32.

He joined the newly organized Omaha Bank for Cooperatives in 1934 as Secretary, and was later made Vice-President and Secretary. In 1936 he became head of the Grain Section of the Cooperative Research and Service Division of the Farm Credit Administration, Washington, D.C. He was appointed Acting Chief of the Cooperative Research and Service Division in 1942 and since 1945 has served as Chief of this Division.

In 1941-42 he worked with the National Committee for Farm Production Supplies. During the war he served as Secretary for the U.S.D.A. Feed Advisory Committee. He was an active member of the American Farm Economic Association, and served as vice-president in 1948. Due to his leadership, a section of the annual program for the past several years has devoted attention to problems in the field of agricultural cooperation. Reference should also be made to his valuable work since 1946 as Chairman of the Research and Education Committee of the American Institute of Cooperation. His tireless efforts to develop an increasing interest among economists, cooperative leaders, and educators as to the nature of the cooperative type of business and its place in our private competitive enterprise system, won for him wide acclaim.

Mr. Hedges was an authority on the cooperative marketing of farm products and was the author of many bulletins and articles in this field. It is significant that on the day of his death, he completed an article, "Marketing Cooperatively" for the 1955 Yearbook of the Department of Agriculture.

Little space is left to record Harold's warmth and kindness. He was a man of character and charm, and the influence of his work with farmer cooperatives will be felt as long as agriculture and the nation are free.

J. K. S.
J. G. K.

JOINT MEETINGS IN DECEMBER

The following programs have been arranged in cooperation with other social science associations for December. These meetings will be held in Washington, D.C., December 27-30. Tentative arrangements are being made for additional meetings, which will be announced later.

Joint Meeting with American Economic Association

FARM PRICES AND FARM INCOMES IN AMERICAN AGRICULTURE; IS AMERICAN AGRICULTURE STILL ESSENTIALLY COMPETITIVE AND LAISSEZ-FAIRE?

Chairman: William Nicholls, Vanderbilt University

Papers: The impact of government programs on farm incomes
M. R. Benedict, University of California
Competition in agriculture: fact or fiction
Gale Johnson, University of Chicago

Discussion: O. V. Wells, Department of Agriculture
Glenn Johnson, Michigan State College

Joint Meeting with American Statistical Association

DEMAND ANALYSIS BASED UPON CONSUMER-PANEL DATA

Chairman: Frederick V. Waugh, Bureau of Agricultural Economics

Papers: The demand for citrus products, by George M. Kuznets, University of California, and Richard J. Foote, Bureau of Agricultural Economics
The demand for meats, by Ayers Brinser, Harvard University
Demand analysis from the M.S.C. consumer panel, by G. G. Quackenbush, Michigan State College

Discussion: Marguerite Burk, Bureau of Agricultural Economics
Margaret Reid, University of Chicago

NEWS NOTES

A Ford Foundation grant to the National Planning Association to evaluate technical assistance in Latin America will entail major studies of developments affecting agricultural research, agricultural extension and education in Latin American countries. The studies to evaluate technical assistance in Latin America are under the direction of Theodore W. Schultz and will be centered at the University of Chicago.

Elected to the U. S. Council of the International Conference of Agricultural Economists were George Aull, William G. Murray, Harry C. Trelogan and G. Burton Wood. Professor Aull was selected to serve as chairman. Joseph Ackerman was re-elected secretary.

Six of the professional personnel of the Bureau of Agricultural Economics received Superior Service Awards from the United States Department of Agriculture at ceremonies held on May 19—Aaron E. Anderson and Cecil J. Borum, State Statisticians of Nebraska and Michigan, for their conduct of the Federal-State Crop Reporting Services in their respective States: Grady B. Crowe (Stoneville, Miss.) for his work on mechanization of cotton, particularly in the Mississippi Delta; Louis J. Ducoff, for his work in the field of farm labor; W. Bert Johnson, for work which resulted in rapid communicaiton of economic information and statistics, through motion pictures, television, and other visual media; and C. Kyle Randall, for his work in developing statistics and analyses relating to economic problems in agriculture.

T. M. Adams, Chairman of the Agricultural Economics Department at the University of Vermont, is returning to full-time duty in the Department after spending part time as Acting Associate Dean and Director of the Agricultural College. He recently served on a committee to study payments to cooperatives in relation to the New York Metropolitan Milk Marketing Order.

G. H. Aull of Clemson College, South Carolina has recently been appointed to the Agricultural Board of the National Research Council.

John D. Baker accepted a position as economist for the M & M Candy Company in Newark, New Jersey at the end of June, 1953. For the past year, after graduation from Purdue, Dr. Baker has been doing commodity analysis work with Longstreet-Abbett Company in St. Louis.

Henry H. Bakken of the University of Wisconsin, is serving as economic advisor to the University of Puerto Rico on problems of marketing research during the summer.

George W. Barr is returning as Head of the department at the University of Arizona. During his two years leave he served as Chief of the Agricultural Section of the Economic Commission for Latin America located in Santiago, Chile.

Roy D. Bass, Division of Field Crop Statistics, Bureau of Agricultural Economics, is improving, following a serious operation.

Rudolph J. Becker, who recently completed course work for the Ph.D. degree at the University of Illinois, has joined the Division of Agricultural

Finance, Bureau of Agricultural Economics. He is currently working on a study of broiler financing.

J. Y. Bhattacharjee has become Acting Assistant Economist in the Food Research Institute of Stanford University, effective July 20, 1953.

Gordon E. Bivens, formerly of Iowa State College, has joined the staff of The Pennsylvania State College as Extension Assistant Professor. He is doing economic information work.

John D. Black of Harvard University will confine his teaching next year largely to two seminars, one in Agricultural Extension and the other in Economics of Land Use and Conservation, the latter in collaboration with Ayers Brinser, John Gaus and Arthur Maass of the Department of Government and Professor Clarence Haar of the Harvard Law School. His course Economics 271, the Economics of Agriculture, will be taught by J. K. Galbraith; likewise Economics 279, Seminar in Agriculture and Land Use Policy.

C. A. Bratton expects to return in September from the Philippine Islands. The Mutual Security Administration contracted with Cornell University to provide personnel to aid in the rehabilitation of the College of Agriculture of the University of the Philippines. He is one of the group who is helping with this work.

L. H. Brown has been promoted to Professor at Michigan State College.

Arthur C. Bunce, Head of the Far Eastern Division, Federal Reserve Board, died at his home in Alexandria, Virginia on May 27. After receiving his doctorate from Wisconsin he worked at Iowa State College and published several books and numerous articles. He joined the Federal Reserve Board in 1943, taking several years of leave at the end of the war to direct rehabilitation operations in Korea.

Dale Butz has been promoted to Associate Professor at Michigan State College.

C. Curtis Cable, Jr., who has been doing graduate work at the University of Minnesota for the past two years, has been appointed Assistant Professor of Rural Economics at the University of Arkansas.

H. C. M. Case, Head of Department of Agricultural Economics, University of Illinois, recently made an inspection trip to India in connection with his duties as chairman of the College of Agriculture's Committee on Collaboration with India. Institutions visited included the Allahabad Agricultural Institute, Allahabad, Uttar Pradesh and the East India Polytechnic Institute, Kahragpur, West Bengal. Four members of the University of Illinois staff are presently assigned to work at Allahabad.

Robert L. Clodius has received a $1,000 Kiekhofer Memorial Award for excellence in teaching at the University of Wisconsin. The purpose of the award is to stimulate interest in good teaching at the University and to honor the late William H. Kiekhofer, long time teacher of economics.

Lee M. Day, Assistant Professor, University of Wisconsin, received the Ph.D. degree from the University of Minnesota in July.

Herrell DeGraff of Cornell University is spending about two months in Columbia this summer with the Rockefeller Foundation.

Hassan Aly Dawood has entered the Egyptian Foreign Service. He is now stationed in Washington and is serving as Second Secretary at the Egyptian Embassy.

Benjamin C. French, formerly at the University of California, has accepted a position as Assistant Professor at Michigan State College, effective September 15, 1953. He will concentrate in marketing.

William E. Hendrix has been appointed Research Associate in Agricultural Economics at the University of Chicago. He will continue his study of the low productivity of American agriculture begun with the National Planning Association's Committee on the South while he was at North Carolina State College.

W. A. Herrington has resigned as fieldman for the Pioneer Farm Bureau Farm Management Association of Illinois to accept a position as Head of the new farm department of the LeRoy State Bank. His service with the Association began in 1929. He is being replaced by R. D. Gustafson.

Clifford G. Hildreth of the University of Chicago has been appointed Professor of Agricultural Economics at North Carolina State College. Professor Hildreth will take up his duties next fall.

Werner Z. Hirsch, formerly of the University of California at Berkeley, has been appointed Assistant Professor of Economics at Washington University, St. Louis, Missouri.

M. D. Jones of the University of Maine is retiring after devoting 27 years in the department. He will be Professor Emeritus and will reside at Blackburg, Virginia.

William O. Jones has been promoted to Economist and Professor in the Food Research Institute of Stanford University.

Joe Koudele has returned to Kansas State after completing the residence requirements for the Ph.D. at Michigan State College.

Earl W. Kehrberg joined the teaching and research staff at Purdue University, July 1, 1953. Dr. Kehrberg will teach courses in Agricultural Statistics and Production Economics at Purdue. Dr. Kehrberg completed his Ph.D. at Iowa State College in June. For the past three years he has been on a teaching and research appointment at Ames.

Robert C. Kramer has been promoted to Associate Professor at Michigan State College.

Kristjan Kristjanson has resigned his position as Agricultural Economist, in which he was cooperatively employed by the Bureau of Agricultural Economics and the South Dakota Agricultural Experiment Station, to join the Agricultural Economics staff of the University of Nebraska.

Milo G. Lacy, Jr., Extension Marketing Economist, resigned from the Extension Service, U.S.D.A., on April 29 to accept the position of General Manager, Richard's Lido Market, Newport Beach, California. Mr. Lacy had been with the Division of Agricultural Economics since January, 1950 working chiefly on the retailer education program.

J. F. Miles, Associate Agricultural Economist at Clemson College, has been awarded a Case Institute of Technology study grant under the "Economics-in-Action" Program.

Arthur Mauch of Michigan State College conducted a course in agricultural policy extension methods at the University of Florida summer school.

Arthur T. Mosher has been appointed Visiting Professor of Economic Development and Cultural Change at the University of Chicago. Dr. Mosher, who has been in charge of the Allahabad Agricultural Institute in India, will carry forward studies to evaluate the agricultural extension programs in Latin America that have been made possible by technical assistance.

L. J. Norton, University of Illinois, conducted a three-weeks course in agricultural policy for extension workers at the University of Arkansas this summer.

D. L. Peery has resigned his position as Assistant Agricultural Economist with the South Carolina Agricultural Experiment Station, effective June 30, to accept a position as Associate Extension Worker in Virginia. He will be engaged in county agent work.

Alvah L. Perry of the University of Maine will be on leave of absence for the college year 1953-54 to pursue graduate study toward the Ph.D. degree at The Pennsylvania State College.

J. S. Plaxico, Associate Professor, Virginia Polytechnic Institute, received the Ph.D. degree from the University of Minnesota in July.

Rex D. Rehnberg has moved from Arizona to Colorado A & M where he is an Assistant Professor of Economics. His position is a combination teaching and research appointment.

Leonard H. Rhodes, who transferred to the Office of Price Stabilization in 1951, has returned to the Division of Land Economics, Bureau of Agricultural Economics.

Lynn S. Robertson started a one-year leave of absence from Purdue University in July, 1953 to serve as Visiting Professor of Agricultural Economics at the College of Agriculture, University of the Philippines, Philippine Islands. Dr. and Mrs. Robertson went to the Philippines across the Pacific. At the end of their year's duty, they plan to return by completing their journey around the world.

Waldo S. Rowan, Assistant Professor at the University of Georgia, received his Ph.D. degree in Agricultural Economics from the University of Wisconsin in June, 1953.

Fred B. Saunders, Assistant Professor at the University of Georgia, has been granted a General Education Board Fellowship for 1953-54. He will spend the entire time at Iowa State College.

Richard Saunders, who is completing his Ph.D. at Cornell University, has been appointed Assistant Professor in Agricultural Economics and Farm Management and Assistant Agricultural Economist at the University of Maine beginning September.

Rainer Schickele participated in a six weeks Latin-American Conference on Land Problems held in Campinas, near Sao Paulo, Brazil, the latter part of May and through June. The conference was sponsored jointly by the Food and Agriculture Organization of the United Nations and the Latin-American Republics. Dr. Schickele delivered a main address on "Evolution of Land

Tenure in World Perspective," and guided discussions in several workshop sessions.

Theodore W. Schultz has been appointed Charles L. Hutchinson Distinguished Service Professor of Economics by the University of Chicago.

G. P. Scoville retired June 30 after 39 years of service. He came to Cornell from his position as County Agricultural Agent in Chemung County, New York, in 1914. He and Mrs. Scoville plan to visit Europe this summer.

Raymond E. Seltzer of the University of Arizona has been granted sabbatical leave to complete course work toward a Ph.D. at the University of California at Berkeley.

Dr. S. C. Shull is on leave from the University of Maryland. He is in Iraq on a Point 4 assignment, engaged in problems connected with marketing of dates produced in Iraq. He is expected to return to Maryland in January, 1954 after a two-year period in his present assignment.

F. M. Simpson, who retired last year as Director of Agricultural Research for Swift and Company, will begin in September his second year as Visiting Professor of Agricultural Economics at Clemson College.

Mervin G. Smith has been appointed Chairman of the Department of Agricultural Economics and Rural Sociology at the Ohio State University and the Ohio Agricultural Experiment Station to fill the vacancy created by the retirement of John I. Falconer on July 1, 1953. Dr. Smith formerly was Agricultural Extension Economist in charge of agricultural policy and outlook work in the same department.

C. L. Stewart, University of Illinois, is on sabbatical leave to study farmland price changes since Pearl Harbor, with special reference to adjustments in appraisals for loan and other purposes. Inspection trips to several areas of the United States are being made.

G. P. Summers, Field Agent in Markets, University of Kentucky, received the Ph.D. degree from the University of Minnesota in June.

Robert Suter joined the extension and research staff at Purdue University, July 1, 1953. For two years prior to that Dr. Suter was Assistant Professor of Farm Management at the University of Missouri. At Purdue University, Dr. Suter will be spending a majority of his time in farm management.

Boris C. Swerling has been promoted to Associate Economist and Associate Professor, Food Research Institute of Stanford University.

Henry C. Taylor received an honorary degree of Doctor of Political Science from the Albert-Ludwig University of Freiburg, Germany, on his 80th birthday, April 16, 1953.

R. B. Tootell, Director of Extension in Montana, moved to Washington State July 1st in the same position.

William H. Wallace has resigned from the Marketing and Transportation section in the Bureau of Agricultural Economics, U.S.D.A., to accept a position as Extension Marketing Specialist at the University of Rhode Island.

David Weeks of the University of California, Berkeley, is on two months leave

of absence to act as an agricultural officer in the service of the Food and Agriculture Organization of the United Nations as a member of the staff of the Land Problems Seminar in Campinas, Brazil.

John W. White, Head of the Department of Agricultural Economics in Arkansas, has been named Associate Director of the Experiment Station.

Willard F. Williams accepted a position as Agricultural Economist with the Federal Reserve Bank of San Francisco in May, 1953. For the year prior to that time he was Agricultural Economist with the California Department of Markets at Sacramento. He completed his Ph.D. at Purdue in 1952.

Joseph Willett has been appointed Research Assistant in Agricultural Economics at the University of Chicago to analyze the developments affecting Negro operated family farms in the United States. This study has been made possible by a grant from the Sears, Roebuck Research Foundation.

J. E. Wills, University of Illinois, is on sabbatical leave for six months studying teaching and research in labor and machinery utilization at various institutions.

Karl Wright was presented an award as the Distinguished Teacher in the College of Agriculture at Michigan State College.

Doctoral Thesis Completed in Agricultural Economics, 1952

Name and Institution	*Title*
Robert L. Tontz Oklahoma A & M College	The Evolution of Agricultural Parity

LAND ECONOMICS

A Quarterly Journal of Planning, Housing & Public Utilities

Founded in 1925

Among articles to appear in May 1953 issue:

The Social Scientist and the Control and Development of Natural Resources .... *Vincent Ostrum*
I. The High Cost of Economic Development ..... *Martin Brofenbrenner*
Public Operation and Regulation of the Abstracting Business ..... *Raleigh Barlowe and Harold Ellis*
The Agrarian Reform in Italy ..... *Carlo Vanzetti and Frank Meissner*
Land Redistribution and Economic Development *V. Webster Johnson and John E. Metcalf*
Housing Design and Family Values ..... *John P. Dean*
The Natural Gas Industry: An Economic Appraisal of Public Policy *Dudley F. Pegrum*
Mechanics of the Urban Economic Base: Historical Development of the Base Concepts ..... *Richard B. Andrews*

Published in February, May, August and November

Annual Subscription $6.00 **Single Copy $2.00**

Sterling Hall, University of Wisconsin, Madison 6